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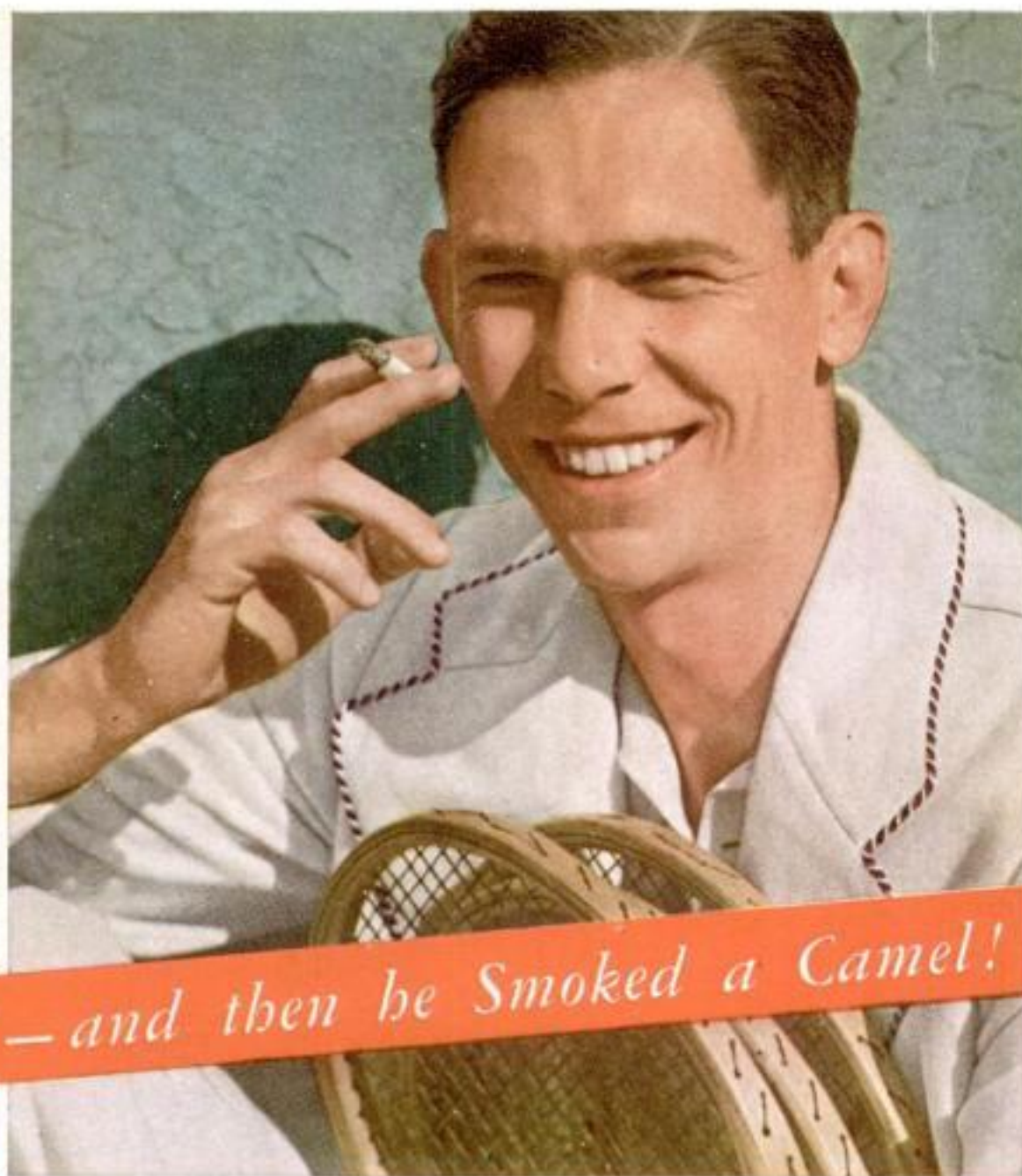
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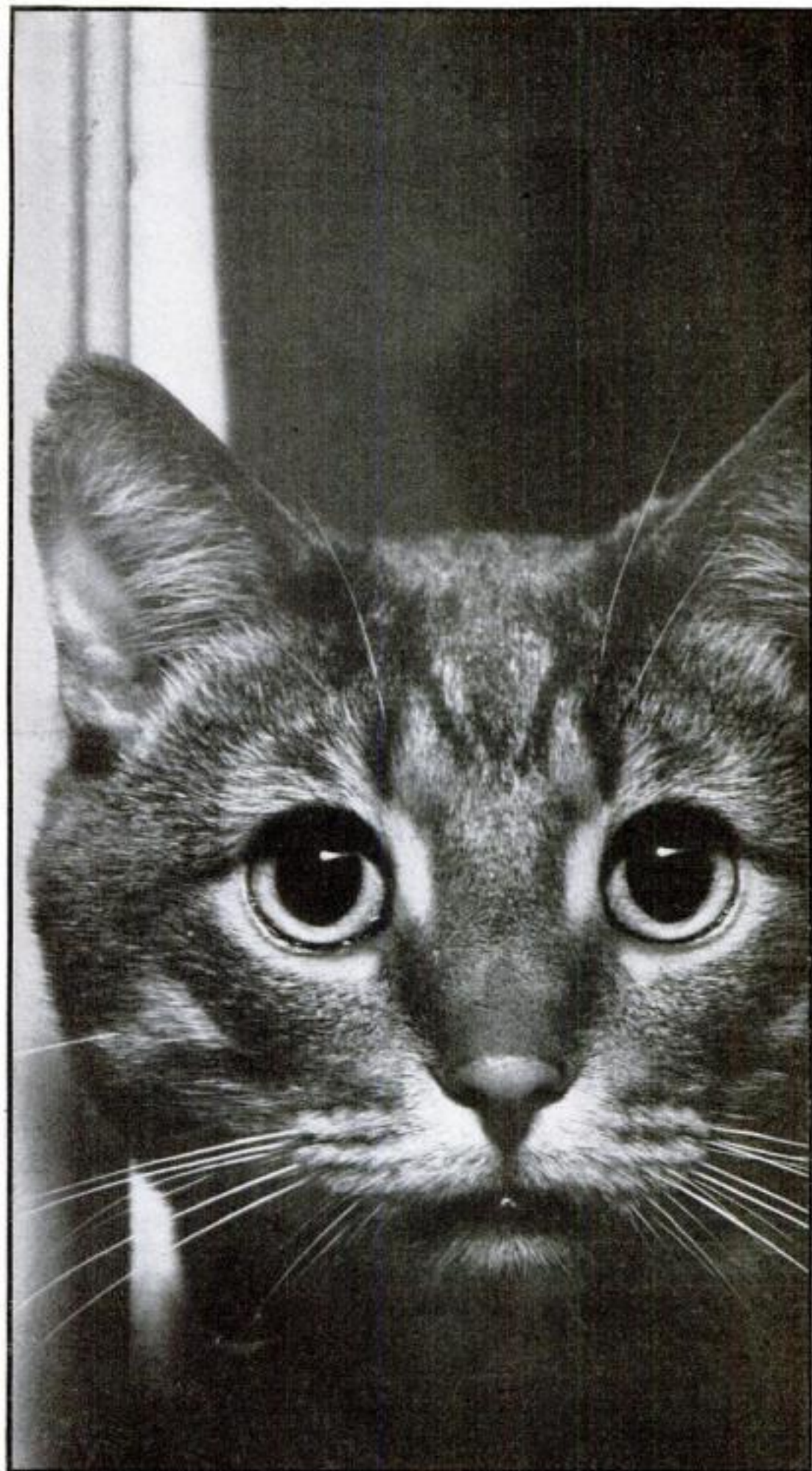


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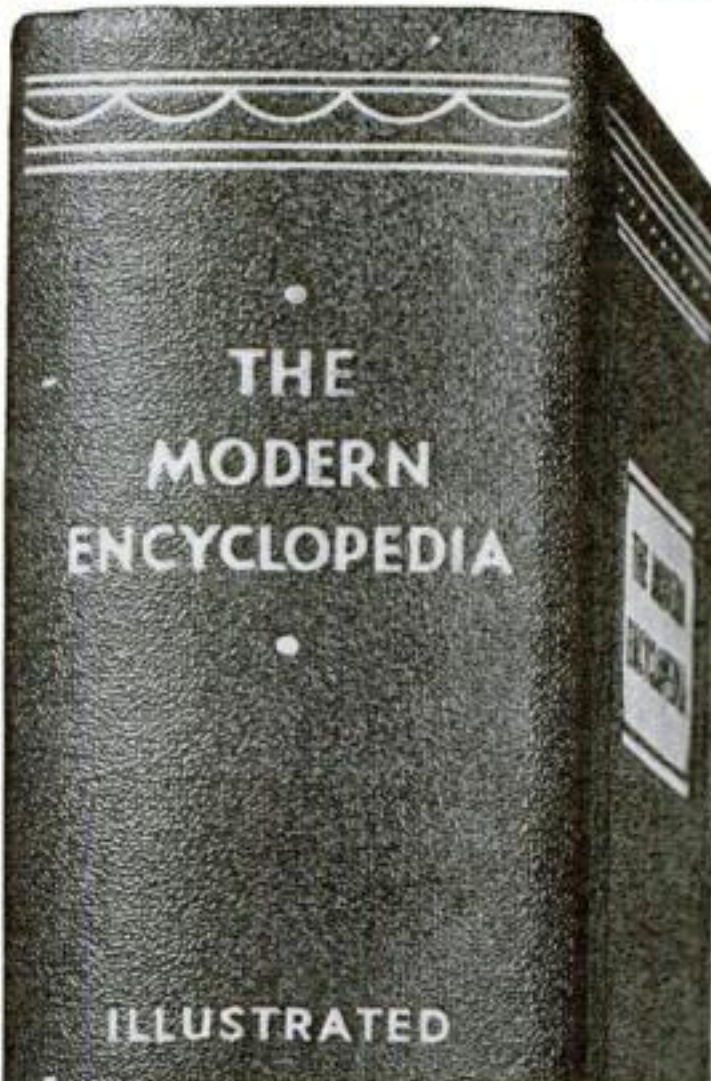
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By R. M. BOLEN
Secretary, Popular Science Institute

A typical re-roofing job, with asbestos shingles being laid directly upon old wooden ones



GIVE YOUR HOUSE A New Roof

BY TREATING your house to a new roof, you can remove many of the wrinkles and scars that give it the appearance of age. Nothing makes a home look older and more in the need of repair than a shabby covering of split and weather-stained shingles.

Considered from the standpoint of cost and effect, re-roofing heads the list of home renovating jobs. Modern roofings are both inexpensive and easy to work. You will find a wide variety of textures and materials. According to your taste and your pocket book, you can make your choice between wood, asphalt, asbestos, slate, metal, porcelain-coated steel, and artistic baked tile.

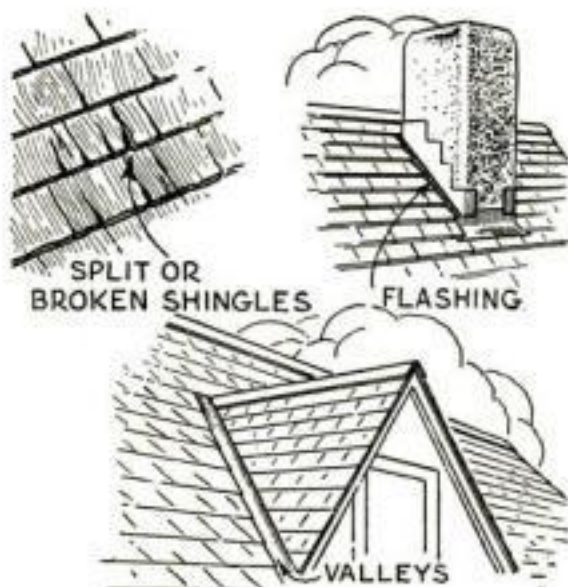
Many homes require the rough, natural

texture of wood shingles to carry out the lines of their design. In such cases, the new roof can consist of new wood shingles applied directly over the old. Although wood shingles can be laid for as little as six or seven dollars a hundred square feet (called a "square" by architects and builders), it is false economy to save where wood is concerned. Use only the first-grade, edge-grain cypress, redwood, or red cedar shingles sold by your lumber dealer and your roof will pay dividends in longer wear with fewer leaks. Cheap shingles generally warp and curl in only a few years' time.

Although shingles are sold unstained as well as stained, it is cheaper in the long run to buy the stained variety. The manufacturer is equipped for thorough staining and consequently can do a better job than you can.

Being fireproof as well as long-wearing, composition shingles form a particularly popular type of re-roofing material. Cheapest of these fabricated roofings is the asphalt shingle consisting of a base of highgrade felt saturated with asphalt and covered with a protective coating of ground slate. This type of shingle is available in a large variety of styles and colors and can be applied for from ten to seventeen dollars a hundred square feet depending on the quality of the shingle and the location of the house. This price, like the others, includes labor as well as materials. If you do the work yourself, the average cost of materials will be about six dollars a square.

Classed as the most sturdy of composition roofings is the asbestos shingle.



Leaks will usually be found at these points

This material consists of a carefully bonded, fireproof mixture of asbestos fibers and cement. Although costing from eighteen to thirty-five dollars a hundred square feet applied, they are well worth the additional cost. Strange as it may seem, high-grade asbestos shingles have been found to improve with age and exposure to the rain and sun.

By using a new type of shingle, the home owner can now combine the rugged, informal appearance of shaggy wood shingles with the sturdiness and fire-resisting qualities of the composition variety. Asbestos shingles are now available that have all the charm and texture of weathered cypress or cedar. Laid, a roof of this type costs between twenty-eight and thirty-five dollars a hundred square feet.

Whether you re-roof with wood or composition shingles makes little difference so far as the work is concerned. In either case, the procedure will be more or less the same.

First of all, there is seldom need to remove the present shingles. The old roof will serve as a fine foundation while the new one will shed the water. The combined thickness of the two will give additional insulation against heat and cold.

It will be necessary in most cases, however, to supply new metal valleys where adjoining roof surfaces meet and new flashing around chimneys and vent pipes. Although new flashings can be placed directly over the old, care must be taken if two different metals are used. Rain water is slightly acid due to the impurities it picks up from the dust and smoke in the air. If flashings of dissimilar metal are allowed to touch, the acid will cause a galvanic action that is bound to result in leaks. For this reason, mount your new flashings and valleys on strips of wood that will space them from the old.

In the actual laying of the new shingles, start at the bottom edge and work toward the ridge. Take care with the spacing and use long box nails instead of ordinary shingle nails to insure a good anchor through the old roof. Because they are less likely to rust, zinc-dipped nails give a more lasting job than nails of the ordinary galvanized variety.

Since both wood and composition shingles are comparatively light in weight, there will be little necessity of increasing the roof bracing when re-shingling with either material. However, if a heavier roofing, such as slate or tile, is used, it will be best to add cross braces and tie boards to the rafters to support the additional poundage.

In sturdiness and appearance, tile and slate are perhaps the aristocrats of roofing materials. However, they also are the most expensive and hardest to apply, especially in a re-roofing job. In most cases, it will be necessary to remove the old roof entirely and start from the beginning.

Another, newer type of roof finish that falls into the same class with slate and tile is a recently developed porcelain finished metal tile. Being made of steel, it will neither warp nor crack and a special method of fastening and joining makes them entirely weatherproof. Tiles of this type are available in a number of styles and colors designed for commercial buildings as well as private homes.

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scores big hit with men!



Now there's no need to tolerate
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WITH this new Vitolized Oil paint, painting starts in the morning. One or two coats are applied. By dinner time everything is in perfect order. Even curtains are up in a room that sparkles with fresh new color! That's Wallhide One-day Painting!

Because it contains Vitolized Oil, Wallhide stays alive and elastic indefinitely. Doesn't chip, peel or blister. It's washable, too, yet costs no more to use than ordinary oil paints. In fact it often costs less because one coat is generally ample. Your Wallhide dealer will gladly show you the 15 alluring petal-like Wallhide colors. See the "flat" satin finish, also the semi-gloss for bathrooms and kitchens.

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In modernizing your home through Federal Government loans or through loan agencies created by the Government, it is essential to use first quality paints that will be approved by the Home Owner's Loan Corporation or the National Housing Administration. Play safe—by specifying Wallhide, Waterspar, Sun-Proof and other famous Pittsburgh Paints.

FREE: Interior Decorators Sliding Color Rule



With this unique sliding rule you can combine colors artistically — actually arrange scores of color combinations to guide you in making your rooms and furnishings more attractive. ALSO FREE: New, beautifully illustrated booklet, "How to Work Wonders with Color in Your Home." Gives new decorating suggestions by Elizabeth Parker, famous New York interior decorator. Simply mail this coupon to: Pittsburgh Plate Glass Co., Paint and Varnish Div., Dept. 1210, Milwaukee, Wisconsin.

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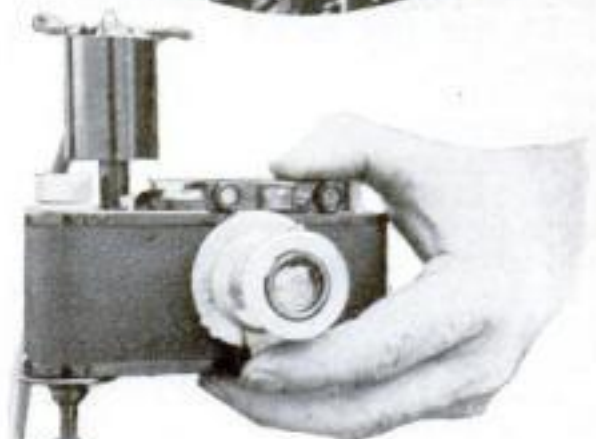
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TODAY there are more than a million and a half General Electric Monitor Top refrigerators in use. Hundreds of thousands of these have been in constant service for over 5 years. The record of their dependable, trouble-free performance is without parallel. 97% of the G-E refrigerators installed in 1929 are still serving their original owners—an amazing tribute to this matchless Monitor Top mechanism.

Here is a mechanism that set new standards in household refrigeration. It was the first electric refrigerator to carry a two year guarantee, the first to be guaranteed three years, the first with a four year service plan, and now is first to give 5 years protection for only \$1 a year. G-E Monitor Top mechanism is hermetically sealed in steel, requiring no attention—not even oiling.

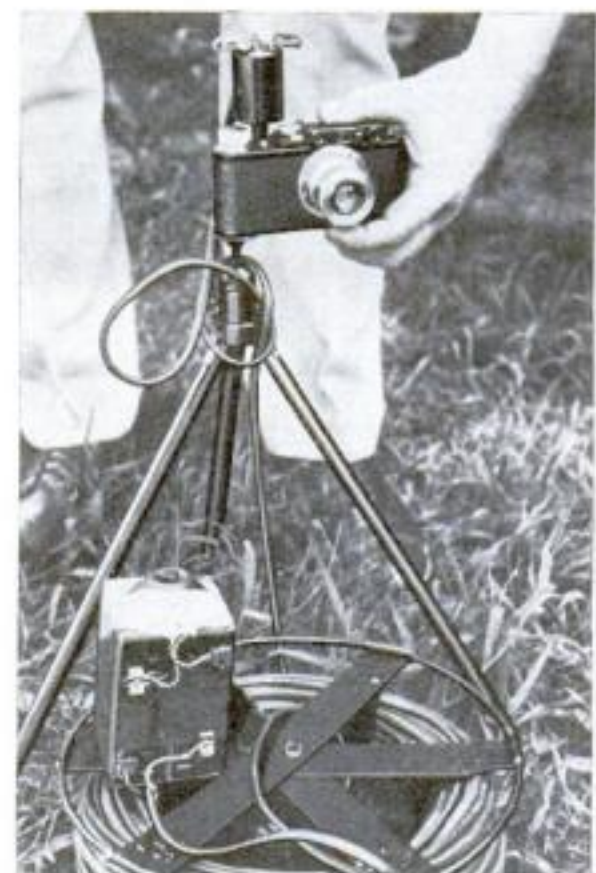
For your nearest dealer see "Refrigeration Electric" in classified pages of phone book. General Electric Co., Sec. M-10, Nela Park, Specialty Appliance Sales Dept., Cleveland, O.

ELECTRIC DEVICE SNAPS CLOSE-UPS OF BIRDS



By means of a homemade electric device, the camera's shutter is tripped from a distant location

REMARKABLE close-up photographs of wild birds have been taken by an Ohio naturalist who uses a home-built electric device to trip the shutter of his miniature camera. Screwed into the top of the camera is an improvised electromagnetic release, consisting of a coil of wire and an iron plunger. When current is passed through the coil, the plunger trips the shutter. The camera is placed as close as possible to the nest to be photographed. Unreeling the 150 feet of control cord, the naturalist retreats to cover and watches the nest through binoculars until the birds are in the position in which he wishes to snap them.



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How a Man of 40 Can Retire in 15 Years



IT makes no difference if your carefully laid plans for saving have been upset during the past few years. It makes no difference if you are worth half as much today as you were then. Now, by

following a simple, definite Retirement Income Plan, you can arrange to quit work forever fifteen years from today with a monthly income guaranteed to you for life.

\$200 a Month beginning at age 55

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It sounds too good to be true. But it is true. There are no "catches" in it, for the Plan is guaranteed by an 83-year-old company with over half a billion dollars of insurance in force. If you want to retire some day, and are willing to lay aside a portion of your income every month, you can have free-

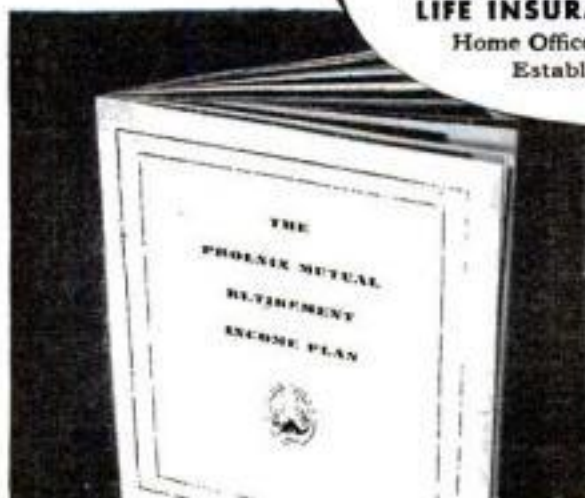
dom from money worries. You can have all the joys of recreation or travel when the time comes at which every man wants them most.

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Our Readers Say



Whatever Happened, It Would Be Fun To Try

Just like G.S.P., Santiago, D. R., I've been bitten by the bullet-problem bug which has been gnawing on so many of your readers. The bite that this insect has left is this: Stretch your imagination and conceive of an airplane that can travel at about the speed of a 100-pound, six-inch projectile of fairly slow velocity. You take out after the shell, pull up alongside of it en route, reach out and pull it into the cabin with you. Then you bank sharply and turn. Now, here's where the problem comes: will the shell turn with you or will it want to tear out of the cabin and keep on its old course? Let your readers' fertile brains figure that one out. I agree with the theory of G.S.P., that a bullet is moving the fastest when it leaves the barrel. It has just received the final boost from the gases and from then on it is on its own. As a parting shot, let everybody figure this one out: I have six crates and twenty-five rabbits. I want to put an odd number of the said bunnies in each crate; how will I divide the rabbits among the crates to get this result?—G.J., London, England.



A Solution for the Great Nail-Brush Mystery

W.L.S., of Rome, N. Y., asked in a recent issue what makes a nail brush float when it is covered with soap. My solution is that the air in the bubbles of the lather gives the buoyancy necessary to support the brush. I like your articles on microscopy and the plans for model airplanes very much. More power to you!—G.J.H., Jr., Burlington, Vt.

He Thinks His Figures Must Be Haywire

HERE'S a problem that has been bothering me: Imagine, if you can, the earth being like a ball—perfectly round and smooth, with no hills, valleys or seas. Now imagine stretching a wire around the earth, which is about 25,000 miles. Cut the wire and add 100 feet of wire to it. Join the ends again, then stretch the wire around the earth so that it will be the same distance above the surface at all points. How far would it be from the earth? Common sense seems to tell me that it would be very little, but figures tell me it would be almost sixteen feet—15.91+ feet, to be more exact. Won't someone please tell me whether my figures are wrong or my common sense has failed me? It may be that I have not proceeded in the right way, to solve the problem.—J.B.K., Bellefont, Kans.



Door Chimes Rang the Bell, According to This Reader

MANY thanks for that article telling how to make a set of electric door chimes (P.S.M., May, '34, p. 65). I made one and it works wonderfully. However, it would not work with an ordinary three-way, bell-ringing transformer. I happened to have a twelve-volt transformer from an old dynamic speaker which kicks that piston over nicely. I am going to put on a different face plate, though, along modernistic lines and about five by nine inches. The four-by-eight plate you have looks a little small in comparison with the length of those tubes.—A.K.B., Chicago, Ill.

He Sat Up All Night To Think Up "Dolichocephalic"

SNORING on a feather bed wastes much of our valuable time, one third of our life being spent in sleep. Time moves swiftly; life constantly shortens; our projects are never completed. When a little knowledge is acquired, we are compelled to lie on the couch of lasting slumber. Think of the things we could accomplish if we did not have to sleep! What we need is a sleep substitute—some concentrated nutrient or restorative that would rehabilitate our bodies, endowing us with perpetual activity like that of moving unicellular organisms. At the present time the fundamental cause of sleep is a moot question. The chemical changes of anabolism and catabolism, and the conduct of the cerebrum in this respect, must be more thoroughly studied. If a sleep substitute could be discovered we could manifest more intense activity and accomplish more enterprises. Consequently, civilization would advance very rapidly. Some of our dolichocephalic scientists should get to work on this.—R.P.B., Baltimore, Md.

WHAT DO YOU MEAN CIVILIZATION?



Starlight Goes Straight, This Astronomer Says

IN A recent issue I saw a letter from A.H., of Glen Ellyn, Ill., in which he said he believed that light from a moving object, such as a star, does not travel in a straight line. I think he is entirely wrong. Not only do the light particles travel straight, but also the beam or path that they make is a straight line. A.H. based his belief upon the fact that water, under the same conditions, will fall in a curved path. It will, but water is a substance and light is not. The air offers resistance to substances. The drops of water are traveling at a uniform rate when they leave the nozzle. The first drop of water is the leader of the stream, and because it has always traveled the farthest, would at any given time be traveling slower than any of the drops following it. As the end drops slacken speed in succession, they describe an outward curve.

But we have no reason to assume that the same thing takes place with regard to light. You can't judge a non-substance by a substance.—L.P.P., Miami, Fla.

He Forgot To Ask for a Simple Planetarium

I HAVE been reading what others have to say in Our Readers Say, and am taking the liberty of mentioning some of the things I would like to see in your magazine. Of course, I don't expect to get all of them, but I do believe that other readers would be interested. How about a miniature camera with a focal shutter? Also a good (and cheap) exposure meter. I should like data on a seismograph, diathermy, figuring and grinding lenses for telescopes and microscopes, A.C. measuring meters, a method of measuring ultra-violet rays, a cheap flexible shaft, and a range finder for use with a camera.—C.E.C., Toledo, Ohio.



That X-ray Lobby Appears To Be Still Going Strong

I AM now thoroughly convinced that a great many of your readers want plans for constructing an experimental X-ray machine. I want to thank E.L., of Philadelphia, for his helpful reply to my letter. Come on, you scientists and electrical bugs, let's hear what you have to say. The construction of such apparatus will be a boon to all the advance medical students, and to those whose hobby is surgery. A tremendous number of experiments can be conducted with the use of X-rays. Viva la X-ray!—M.P., Brooklyn, N. Y.

Expansion of Metals Would Run Fly-Power Plant

ANSWERING the question of S.E.J., of Los Angeles, Calif., about getting power from the expansion of metals: The coefficients of linear expansion of lead and zinc are .000028 and .000026, respectively, for degrees Centigrade. The expansion of a metal is equal to the length times the coefficient times the change in temperature as measured in degrees. If the difference between night and day temperatures was ninety degrees Fahrenheit (quite a bit more than ordinarily occurs) it would be fifty degrees Centigrade. Assume 100 feet (linear) of each metal, and the expansions would be .14 and .13 feet. If this power could be used to move 100 pounds, then the power developed would be fourteen and thirteen foot-pounds per day. This is the equivalent of .000011 watts. As a source of power, it would be more



practical to capture a few flies and put them in harness.—L.H.T., New York City.

This Ultra-Modern Girl Gets Music from a Toaster

ALTHOUGH I am a girl I thoroughly agree with D. Y., Utica, N. Y., about wanting more information on one-tube radio sets. My brother takes POPULAR SCIENCE MONTHLY but I believe I absorb twice as much from it as he does. About a year ago several of us organized a chemistry club, and the articles by Raymond B. Wailes have helped me a lot. Now I have fallen for one- and two-tube radio sets. I have constructed a miniature radio set in an old electric toaster and it has attracted a lot of attention for its novel appearance. It is really useful, too, as it has very good reception.—S.V., St. Joseph, Mo.



Fire on the Sun Proves To Have Been a False Alarm

WHO told C. F., Chicago, Ill., that the sun is burning? Burning of matter on the sun would produce oxides; but, due to the great heat (about 10,000 degrees Centigrade on the surface and possibly millions of degrees in the interior) few if any compounds could or do exist on or in the sun. Probably the greatest source of heat is from contraction of the sun itself. A more recent hypothesis would have it that the sun's heat is the result of destruction of atoms. According to authorities, there is little or no burning or oxidation on the sun. To substantiate the contraction theory, astronomers say that the sun has contracted from a huge volume of gas to its present size and density. I believe that this will answer C.F.'s question.—D.A.C., San Diego, Calif.

This Ought to Get a Rise from the Astronomy Fans!

BY SYSTEMATICALLY arranging and performing the experiments described by R. B. Wailes in POPULAR SCIENCE MONTHLY, I am obtaining a complete review of my high-school chemistry, in addition to learning of new experiments not found in any chemistry texts that I have seen. More power to Mr. Wailes and his section! The chemistry and microscopy departments, to me, are alone well worth the cost of the magazine. If it were possible, I should like to see the magazine about half chemistry and the remainder microscopy, though I suppose this wouldn't please everybody.—W.B.F., Atlanta, Ga.

P.S.M. Leads Again with Screw for Left-hand Driver

HAVE you ever seen a left-hand wood screw? Well, I have!—on page 43 of POPULAR SCIENCE MONTHLY for March. Look at the wood screw being carried by the "fly-high" man and you will see that the thread runs in such a direction that the screw could be driven in only by turning it to the left. No doubt this is a screw for use with the familiar left-hand screw driver, which I always believed to be a joke. It is winter here now and we have just had fifteen consecutive fine days with bright sunshine and not a breath of wind. How's that for climate?—G.S.L., Newcastle, Australia.



New "Old Reader" Wants More Advanced Hook-ups

I AM one of your many new admirers, having started reading POPULAR SCIENCE MONTHLY in June, 1933. If it were any other magazine I would call myself an *old* admirer, but after reading about the many fans who have copies of the paper dating back to the time of Julius Caesar, I feel like a mere infant. Now to get on to the subject: In a recent issue G.R.S., of Portland, Ore., asks for more one-tube radio hook-ups. He also says he has been a steady reader for many years. Wouldn't you think that he would get tired of putting together the same parts on a different type baseboard? Can't we have a few more advanced hook-ups to choose from? I am sure many of your radio fans will agree with me.—C.B.C., Mahone Bay, N.S., Canada.

This Reader Wants More About Automobile Driving

I HAVE just read, with delight, Fred Frame's article on automobile driving in a recent issue of POPULAR SCIENCE MONTHLY. I do not hesitate to voice the opinion that this article interests and informs more of your readers than anything you have previously published. There is a crying need for information on driving, beyond the primary stuff. In fact, I think license requirements should be extended to cover "advanced" driving. I earnestly hope that you will soon follow this article with others along the same line, including traffic driving. For instance, I would like to see an article on what to do when a crash is inevitable; what defects in a car are dangerous and how the driver may detect them; how to handle the special passing problem on four-strip roads and on one-way streets; how to get away when the light changes, and so forth. Give us some more of this "driving dope for grown-up men."—A.W.M., New York City.



A Plea for Tolerance Among Hobby Riders

I DISAGREE with W.B., Folcroft, Pa., when he says that anyone who is not interested in astronomy is abnormal. I am not interested in astronomy, yet I claim that I am quite normal. I like to read about new astronomical discoveries occasionally, but not to study the subject. I am a little more broad-minded and willing to let everybody have his own tastes and not say he is abnormal just because he does not like what I like. I am very much interested in all kinds of ships, from motor boats to ocean liners, and also in aircraft and locomotives. I would appreciate it if you would print more about these things.—W.A., Salt Lake City, Utah.

P.S. Will Like the Series That Started in August

WITH reference to the article, "Small Ships Built in Sets," by Theodore Gommi, permit me to compliment you on having secured the services of a man who, I think, has some very interesting new ideas. His plan of first painting the separate parts before putting them together is so effective and yet so simple that I wonder how it is that neither I nor any of my friends who are interested in this work, have not thought of it before. You have asked your readers what type of models they prefer. For myself, I am more interested in the naval models than in the commercial ones. Models of some dreadnaughts or of the plane-carriers would interest, I am

sure, many of your readers. I hope that I shall see many of Mr. Gommi's perfect models in the future.—P.S., New York City.

Reader Insists on Good Working Conditions for Goats

SOLVING the goat problem, I find that sixty feet of rope will be needed for the second goat. No guarantee about that last two tenths of a square foot of pasture unless you (1) provide goats with a mosquito taper for getting the grass between the silo and the fence, and (2) fasten the rope to the extreme grazing end and not around the neck as in your picture. Here's another problem for your mathematicians: The theorem of Pythagoras is still true if in it the word "square" is everywhere replaced by "equilateral triangle." Can any of your readers cut up the equilateral triangles on the legs of a right triangle into parts that can be reassembled to form the equilateral triangle on the hypotenuse?—A.J.G., Ann Arbor, Mich.



Tough Birds Like This Should Be Kept Off the Road

HERE'S one to add to your list of queer things that happen to people in cars. A friend of mine was driving home one evening when a rooster flew out in front of the car. It split the radiator of the car, but the rooster is still alive. Will one of your readers please tell me which state of matter flame is?—M.B., Hunter, N. Y.

He Gets a Kick from Other People's Letters

OUR Readers Say is to me a very interesting department. In its columns you can see not only letters but the people behind the letters—the people who demand door bells for dogs, and that the chemistry editor invent a superstickum for sealing letters. Such ideas! Some of the explanations of the variation of the speed of light were very interesting (interesting is all I can say for them, though, for even if you follow every word closely, you don't get anywhere). A cure for hiccoughs from (of all places) Topeka, Kans. The best thing about Our Readers Say is its method of spreading knowledge and the opportunities it affords for getting information from other readers. For example, E.G., of Grand Rapids, Mich., who will undoubtedly get an answer to his question about alcohol and chromic acid.—R.D., Jr., Chicago, Ill.

—And Add a Rumble Seat for Sister and Her Beau

Now that trains and automobiles are being streamlined, why not extend the benefit of this new development to houses? I would suggest a house constructed in such a manner that, no matter from which direction the wind blew, it would always present a streamlined surface. This would reduce the strain put upon the house by the wind, and make lighter construction practical. I would also equip this house with knee-action foundations so as to prevent damage by earthquakes, the house riding over the waves of an earth tremor as a modern car takes the bumps of a rough road.—W.M.P., Jr., Baltimore, Md.



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RAYMOND J. BROWN, Editor

Air Corps officers say that in the next war planes will drop two-ton bombs on the big cities destroying them by explosions and fires and killing the inhabitants with poison gas. Others say such attacks are very unlikely

MACHINES THAT WILL FIGHT THE Next War

MANY writers have painted grim and lurid word pictures of the next war—pictures of mighty cities blown into reeking ruin by a hail of bombs from out of the sky; of the merciless slaughter of combatants and noncombatants alike with gases a hundred times more deadly than the mustard and phosgene of 1918, and with the stealthily sowed germs of malignant diseases; of gigantic tanks, land battleships that will crush thousands beneath their grinding tracks. They have drawn pictures of air armadas so mighty that they will decide the issue before ever a soldier marches across a frontier; of robots that will do the front-line fighting in place of flesh-and-blood men; of strange electrical weapons that will send dreadnaughts plunging to destruction and wipe out armies before they can fire a shot in defense; of war so terrible and so devastating that it will annihilate our civilization.

Will the dreaded, but prepared-for, next war, when and if it comes, really be like that?

Few of our military experts on duty at the War Department in Washington think so, but they do think future wars will be vastly different from the World War. They expect the next war to be a war of speed, surprise, and shock, rather than another 1914-1918 trench deadlock to be broken only by slow attrition. They expect the armies of the future to be considerably smaller than those of the recent past, but more highly trained, and provided by science with implements and weapons that will give them great speed of movement and terrific hitting power.

On the part that the airplane is likely to play in future

By
ARTHUR
GRAHAME

DAY BOMBERS
ARE FORCED
TO 27,000-FT.
ALTITUDE BY
RANGE OF ANTI-
AIRCRAFT GUNS,
MAKING ACCURATE
BOMBING
DIFFICULT

27,000
feet

NIGHT BOMBERS
CAN DESCEND TO
15,000 FEET BEFORE
SEARCHLIGHTS
PICK THEM UP,
BUT ADVANTAGE
OF LOWER ALTITUDE
IS OFFSET BY
DARKNESS OF
TARGETS

15,000
feet

COMPARATIVE
SIZE OF
TARGET

1,200
feet

wars, American military opinion is sharply divided. The General Staff opinion is that the airplane is an important and highly valuable weapon, but merely one of many weapons, and like all other weapons it will be used principally to help the infantry advance and conquer. Air Corps officers, however, are firmly convinced that the rapid development of the airplane has changed the entire aspect of warfare, and made armies and navies of decidedly minor importance and that it will be air power, and air power alone, that will decide the wars of the future.

Air-minded American military men have been profoundly impressed, as have the air-minded of all other nations, by the theories of air warfare advanced by General Giulio Douhet, an Italian soldier-scientist who died in 1930.

While the airplane was still in its experimental stage, Douhet realized that it would become an important factor in future wars. After the World War he became the prophet of the independent air force. The aviation forces, he preached, should not be under control of either military or naval commanders. At the very beginning of a war all of a nation's air power should be massed and used to win the mastery of the air at the earliest possible moment. Bombing planes should be armed so that they could defend themselves successfully against attackers, but enemy air power should be destroyed by bombing its hangars and factories out of existence, rather than by seeking combat with its planes. The mastery of the air won, it should be used to bomb cities and strategic points on transportation routes, so as to break down the morale of the enemy civilian population and make it unwilling to continue the war.

While no nation has gone the whole way in accepting Douhet's theories, Italy, Great Britain, France, Russia, and Germany have adopted his idea of the independent air force. The United States and Japan are the only top-flight military nations that still divide their air forces between the army and the navy.

News from many countries shows that their military authorities are really fearful of air attacks on their great cities. Somewhere deep under London—the exact location is a carefully guarded secret—work has been started on an immense bomb-proof and gas-proof subterranean chamber designed to be the nerve center of the British capital's defense against air attack. In Tokyo and other Japanese cities, military and municipal authorities are adopting measures intended to

safeguard electric power plants, water works, and other vital public utilities from danger from the skies. France is working out an elaborate system for protecting her population against attacks by planes.

Air Corps officers are convinced that large-scale air attacks on great cities will be a development of the very early days of the next war. They emphasize the fact that Paris, Berlin, London, Rome, and Tokyo all are within easy striking distance of the air bases of possible enemies.

An air attack on a large city probably will not be an attempt to demolish the entire city with a rain of high-explosive bombs. The areas attacked will be limited in size in proportion to the number of planes available for the attack, and will be carefully selected for their strategic value. Air attacks of this character on two or three well-separated areas of a city such as New York or London would, Air Corps officers insist, result in the complete demoralization of its inhabitants. It is quite possible that they might result in the destruction of the entire city by fire.

No military expert doubts that in many cases massed air attacks on important cities will be possible, and few doubt that they will be made. But many students of modern war doubt that they will be anywhere nearly so destructive as the proponents of air power think, or that they will have a sufficiently strong effect on civilian morale to make them worth while. World War air raids were severe enough to prove that civilians don't scare easily.

Air bombs, however, have increased greatly in size since the World War. The largest that were dropped on London and Paris weighed 660 pounds. Today ordnance experts are experimenting with a two-ton bomb, and one-ton bombs are considered standard. One of these missiles, exploding on striking the ground, makes a crater fifty-seven feet in diameter and nineteen feet deep. But it would not penetrate very far into a modern steel-and-concrete building. If it struck the Empire State Building it would wreck two or three of the upper floors, and its terrific blast probably would kill everyone on them, but it would not destroy the building. It is certain that at present no nation has anything like enough planes to carry the number of explosive bombs that would be necessary to destroy a large city.

Incendiary bombs, especially thermite bombs, would be much more damaging. Thermite is a mixture of aluminum powder and oxide of iron. When a small part of the bomb's charge is raised

2,000 POUND BOMB
CARRIES 1,000 LBS.
OF EXPLOSIVE, BUT HAS
LITTLE PENETRATION

2,000-POUND SHELL
CARRIES ONLY 58 LBS.
OF EXPLOSIVE, BUT HAS
GREAT PENETRATION
AND ACCURACY.

A BATTERY OF 4 ANTI-AIRCRAFT
GUNS CAN PUT 100 26-POUND
SHELLS INTO AIR
A MINUTE



UPPER FLOORS ARE SAFE ZONES IN GAS
ATTACKS AS GASES CLING TO GROUND.

Drawings by
B. G. SEIELSTAD

to a high temperature by a primer, a violent reaction is set up which causes metallic iron to flow out as an incandescent liquid. When thermite is mixed with a high explosive, its driven drops will penetrate steel. Planes dropping 100-pound thermite bombs on a city, especially on a windy day, could start so many fires that the fire department might be unable to control them.

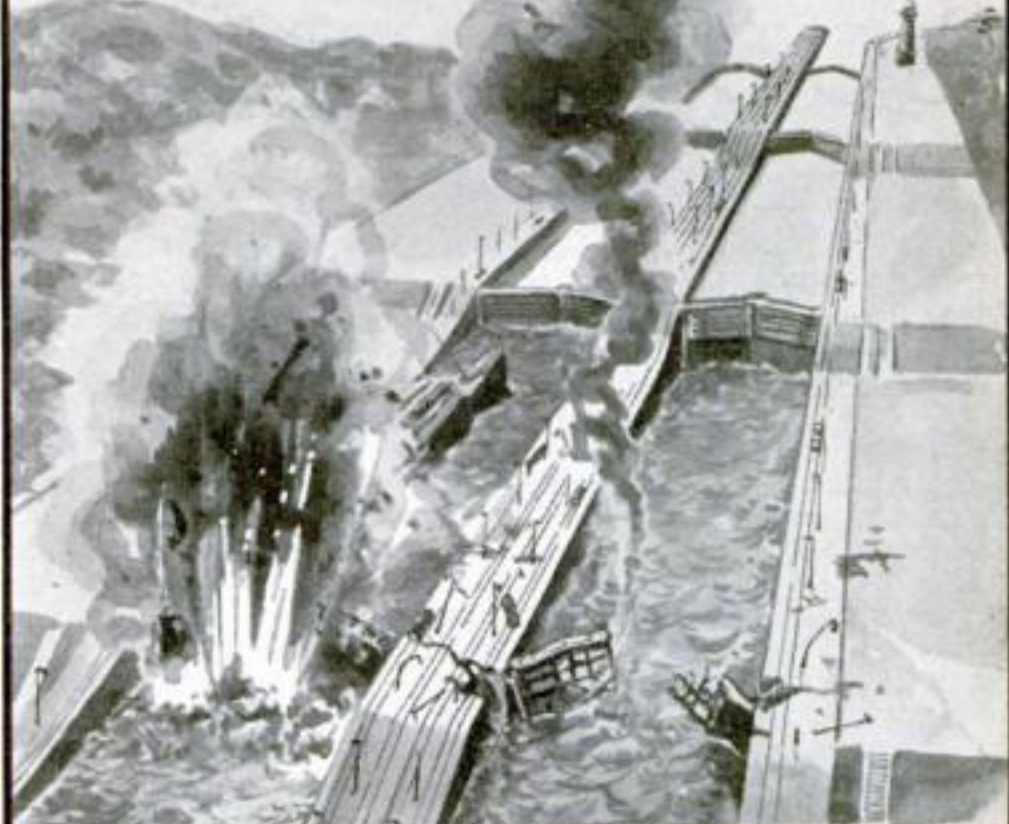
Although the use of poison gas in warfare has been outlawed by international agreement, it is so valuable a weapon that it probably will play an important part in future wars. But, valuable as it is, it is not nearly so effective as most of the next war writers have made it out to be. Our military experts say that no new gas has been invented since the end of the World War, and that mustard gas still is the most effective chemical-warfare weapon.

Undoubtedly, mustard gas will be used in air attacks on cities. A single plane could carry enough of it to kill every person in New York—provided each person was obliging enough to inhale a whiff of it. But they wouldn't be! Twelve thousand tons of mustard gas was used in the World War. It caused 350,000 casualties, and killed about 6,000 men. So it really takes about two tons of the most effective gas now known to kill a single soldier.

If the people of a city were trained to keep cool during an air attack—and the people of European cities are receiving such training—mustard gas released from bombs would cause few casualties. The civilians could take refuge on the second floors of their homes—mustard gas always stays close to the ground—and be perfectly safe from it until firemen and emergency crews wearing masks and protective clothing washed it down the sewers with streams of water.

Another bogey often trotted out by writers on future war is that of attack with disease germs scattered by airplanes. Army medical men who have studied the subject carefully say that there is little danger that any nation ever will attempt to use this biologic weapon. Bacteria are easily destroyed by heat, and so can not be used in bombs or shells. Modern sanitation probably would be able to keep the transmitted diseases under control.

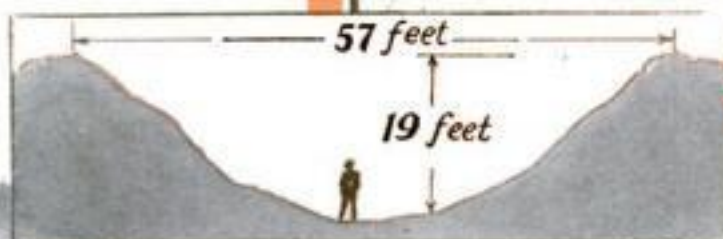
NUMEROUS WAYS COULD BE DEVISED TO WRECK A PAIR OF LOCK GATES TO TIE UP PANAMA CANAL



DAMAGING GATUN SPILLWAY WOULD LOWER THE WATER IN GATUN LAKE



PANAMA CANAL WOULD BE OUT OF COMMISSION IF DAMAGED AT THESE 8 POINTS



ONE 2,000 POUND BOMB DIGS A HOLE THIS SIZE IN ORDINARY SOIL

ONLY THE TOP FLOORS AND TOWER OF EMPIRE STATE BUILDING WOULD BE WRECKED IF A DIRECT HIT WERE SCORED

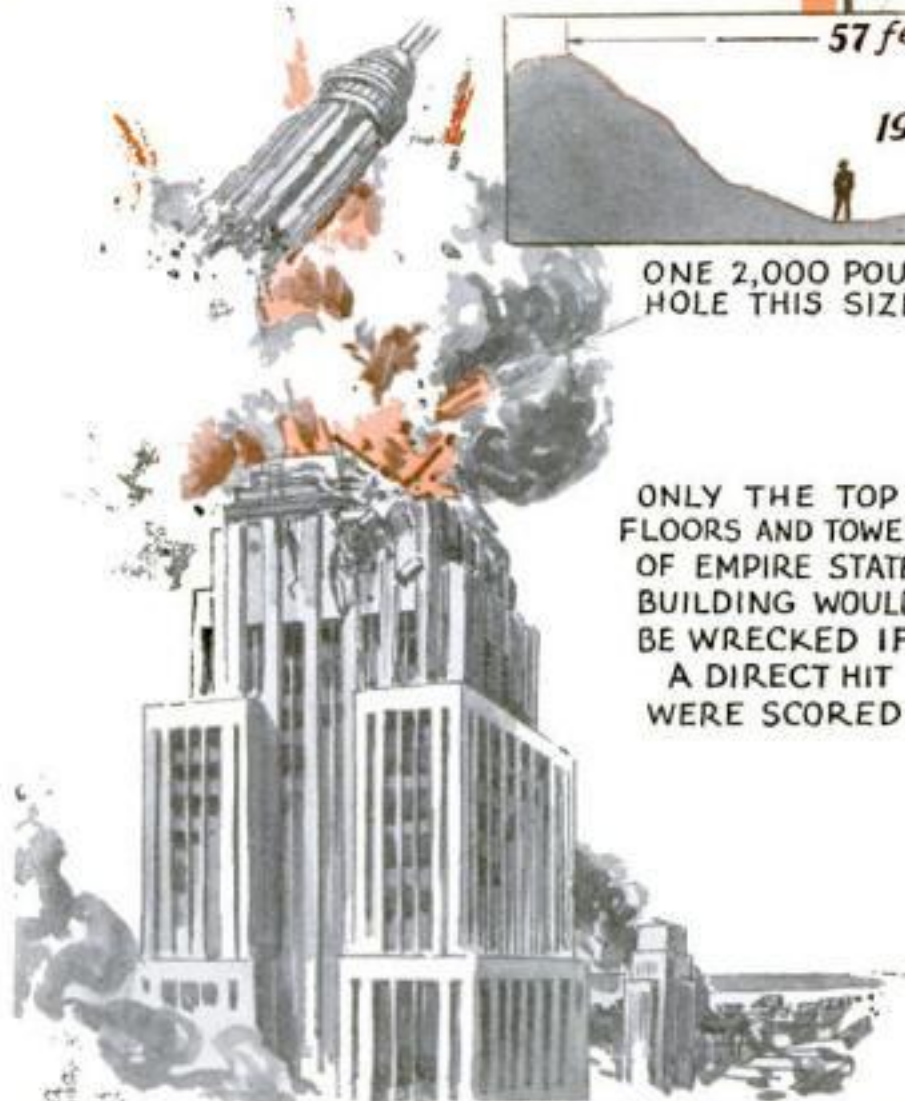


Illustration shows how the biggest bomb now carried by airplanes would shatter only the top floors of the Empire State Building

And if the diseases did become epidemic they would be almost certain to have a boomerang effect, for it would be impossible to keep them from spreading to the forces of the nation that had unleashed them. Germs make no distinctions between uniforms.

It has been said that planes could drop deadly poisons on enemy cities. They could. Botulinus toxin is one of the deadliest of poisons. A single scout plane could carry enough of it to kill everyone in the world—provided that its lethal load could be administered directly to the prospective victims. But in warfare it couldn't be so administered, and released at random over a city it would have only a slight effect.

Separated by 3,000 miles of Atlantic and 6,000 miles of Pacific salt water from the nearest nations that could become formidable enemies, the United States has a much simpler air defense problem than have nations whose potential foes are within two or three hours' flying time of their capitals and industrial centers.

Although some Air Corps officers think that aircraft with a flying range of 7,000 miles while carrying a ton of bombs will be built in the near future, the present extreme radius of airplane action under war conditions is about 900 miles. Under existing conditions an Asiatic or European enemy attacking us from the air would have to launch (*Continued on page 120*)

Man-Made Lightning SOLVES NATURE'S FREAKS

By **ALDEN P. ARMAGNAC**

FORKED lightning played overhead as a farmhand hurried across an Antwerp, N. Y. field for shelter. Suddenly there was a blinding flash and a terrific crash of thunder. The man was thrown, unconscious, to the ground. When he regained consciousness, he rose and examined himself for injuries. The skin of one leg was slightly blackened; that was all. Then he reached in a pocket and drew forth what had been his silver watch. Torn and fused, it gave mute evidence of the power of the electric bolt that had struck it. How the farmhand himself had been spared, he did not bother to inquire.

Once science was at a loss to explain such odd pranks of lightning. Why did it sometimes kill a man it struck, and at other times merely melt a watch or a bunch of keys? How could it leave its photograph imprinted in a branching pattern on a household mirror in a home it had struck? Why did it sometimes take the destructive form of a shattering blow that tore a mighty tree to pieces, and on another occasion, playfully run down the chimney of a house and light a fire laid in the kitchen stove?

I have just come from the high voltage laboratory of the General Electric Company at Pittsfield, Mass., where the answers to these and similar questions are being sought and found. Here scientists have had at their command, for many years, mighty electric generators producing flashes of millions of volts. Recently

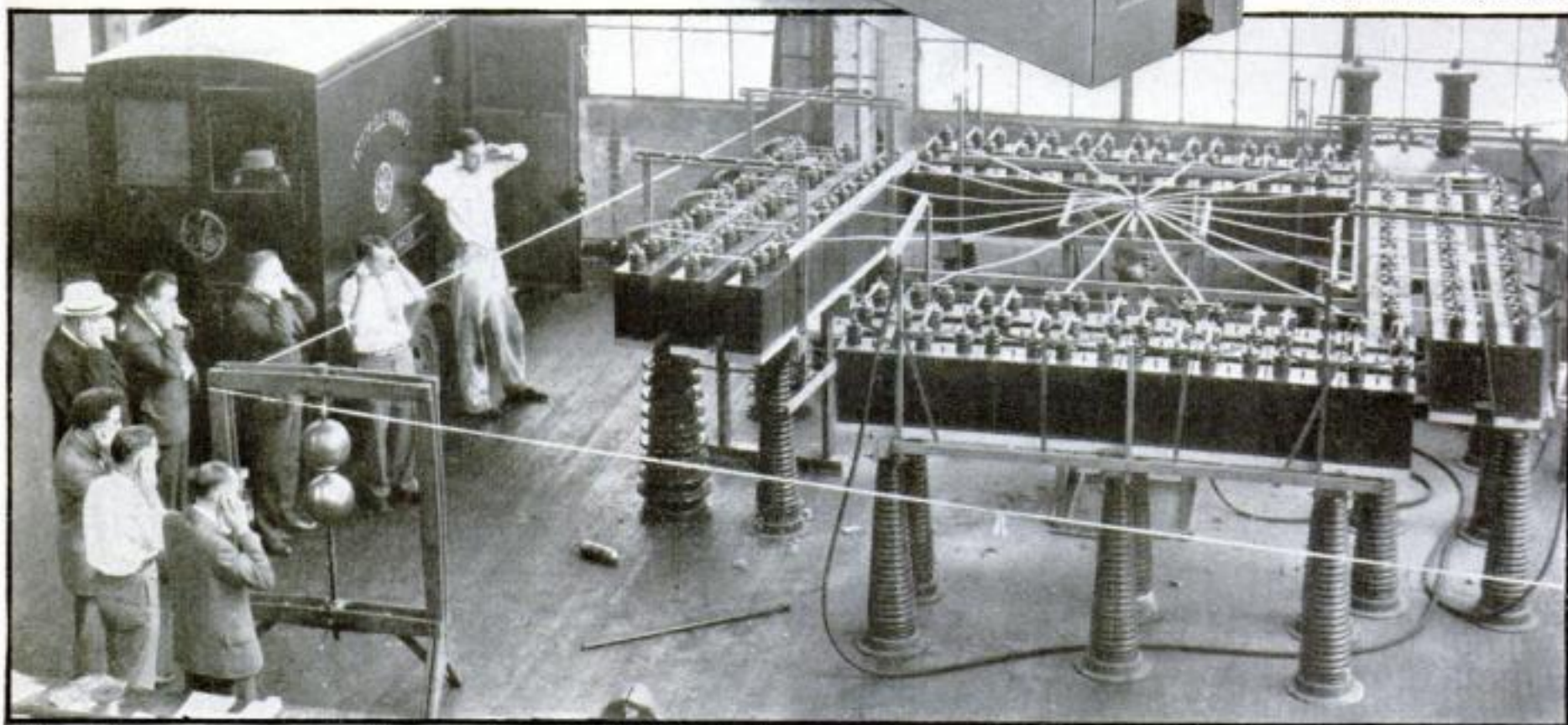
they have installed the newest and most potent machine of all which releases a thunderbolt that reproduces exactly the terrific effect of natural lightning in all its destructiveness, so that it may be observed and studied.

Outwardly the new generator, whose first public demonstration I witnessed, gives little hint of its enormous power, for it is surprisingly compact. Four rows of big metal boxes, perched on massive insulators and grouped in a hollow square, serve to store the 150,000-volt



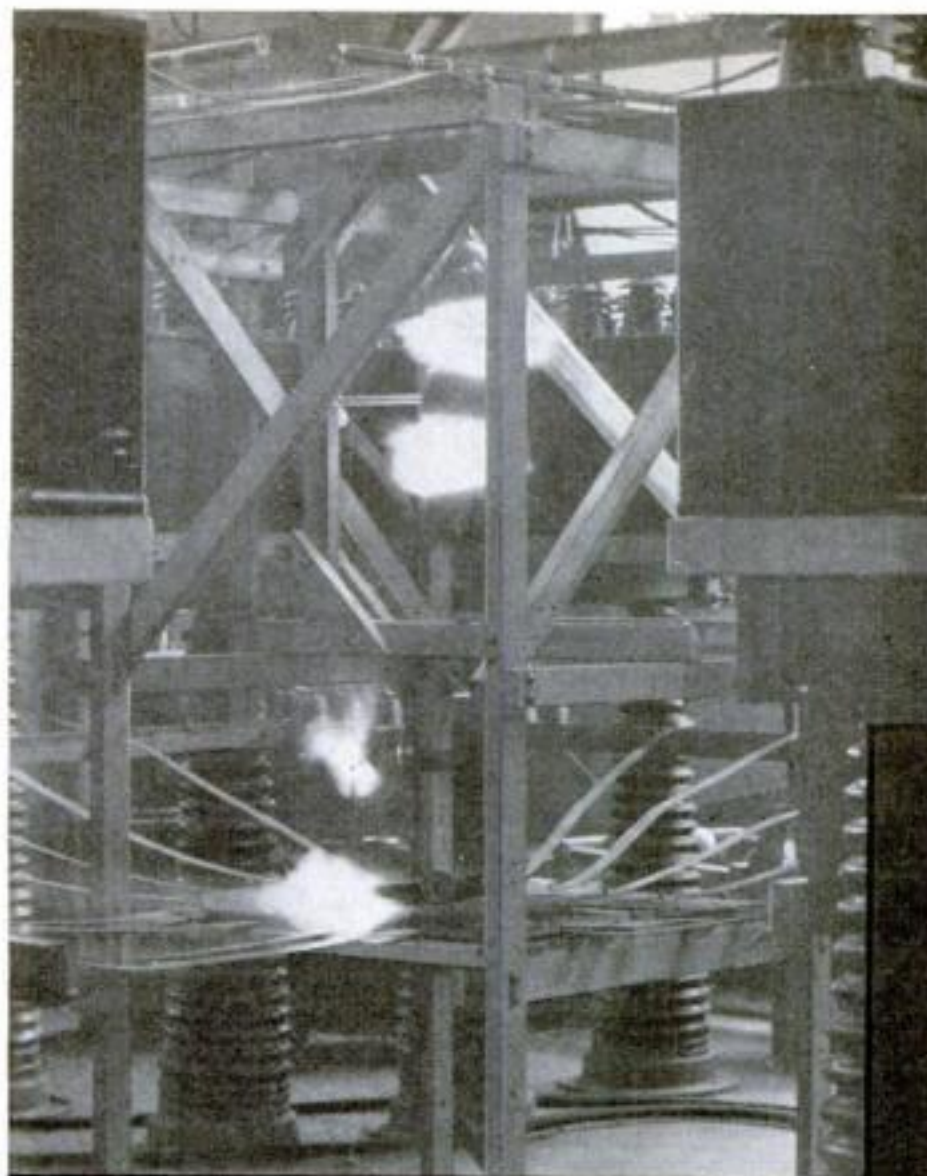
©Henry A. Shimer.

Above, one of the most remarkable photographs of lightning ever taken. It shows a bolt hitting the Empire State Building. Left, model house after it was struck by man-made lightning



This mighty new generator, which can release a lightning bolt of a quarter of a million amperes, is being used in the high-voltage laboratory of the General Electric Company. So powerful is the current that this man-made lightning has all the kick of a real flash

Age-Old Mysteries of Electric Phenomena Cleared Up by Thrilling Work with Big Generator

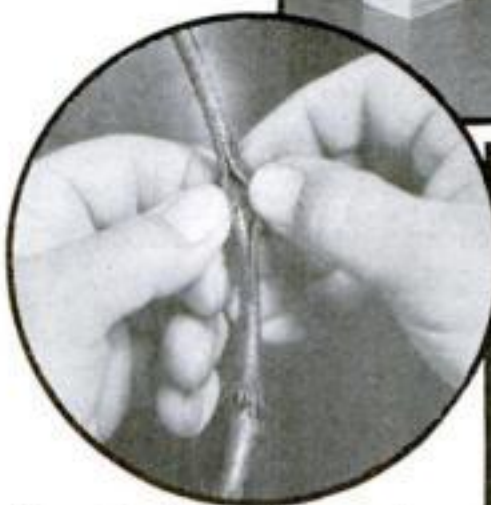
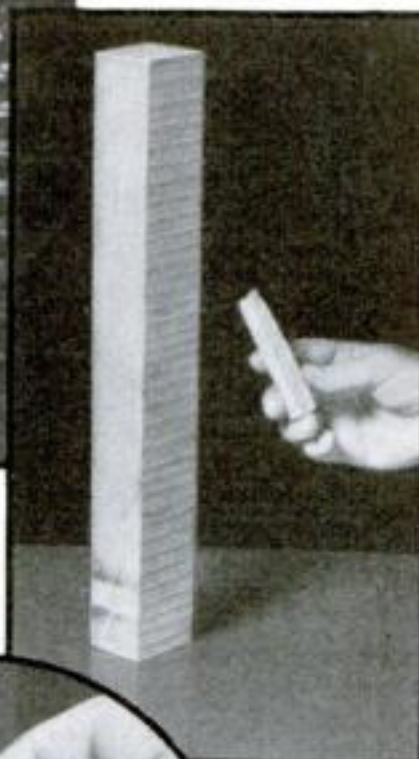


Above, a quarter-million-ampere discharge that is said to be equivalent to a six- to eight-inch slice of the business end of a real thunderbolt. Right, small splinter was the biggest piece found after artificial lightning hit a block like the one seen in picture

current fed to them by transformers and rectifier tubes at the rear. The boxes are known as "capacitors," and are big brothers of the condensers used in radio. It takes about thirty seconds to charge them, and a hissing noise like a lawn sprinkler is heard during the process. From a distant point, an operator then short-circuits the entire bank of condensers at once, and an electric flash of a quarter of a million amperes crashes across a gap between spheres at the center of the square. The magnitude of this current is appreciated when it is realized that to carry it continuously would require a solid copper conductor three feet in diameter.

It is this ability to produce so huge a current that distinguishes the new generator from the others in the laboratory. The latter operate at higher voltages, and can make a spark leap dozens of feet, but the amount of electric current that actually flows is a mere trickle compared with the torrent of electric energy released by the new one. And it is current that gives the new generator, like lightning itself, its kick. According to K. B. McEachron, head of the high-voltage laboratory, its discharge represents a slice six or eight inches long of the business end of a full-fledged lightning bolt. By placing any object in its path, the effect of natural lightning may be duplicated and studied.

When the new generator is running, red danger lights on the stairway to the gallery in the great transformer shop where it is housed warn everyone against approaching. Things are likely to fly. Observers stand behind a heavy wire screen.



Above, insulated telephone wire hit by man-made thunderbolt has lost its wire which was vaporized and escaped through insulation. Right, copper strap as it appeared before and after current hit it



Above, a memorial column burst open by the explosive effect of lightning. Left, house with windows blown out and walls bulged by a thunderbolt as though a big bomb had been deliberately exploded inside it

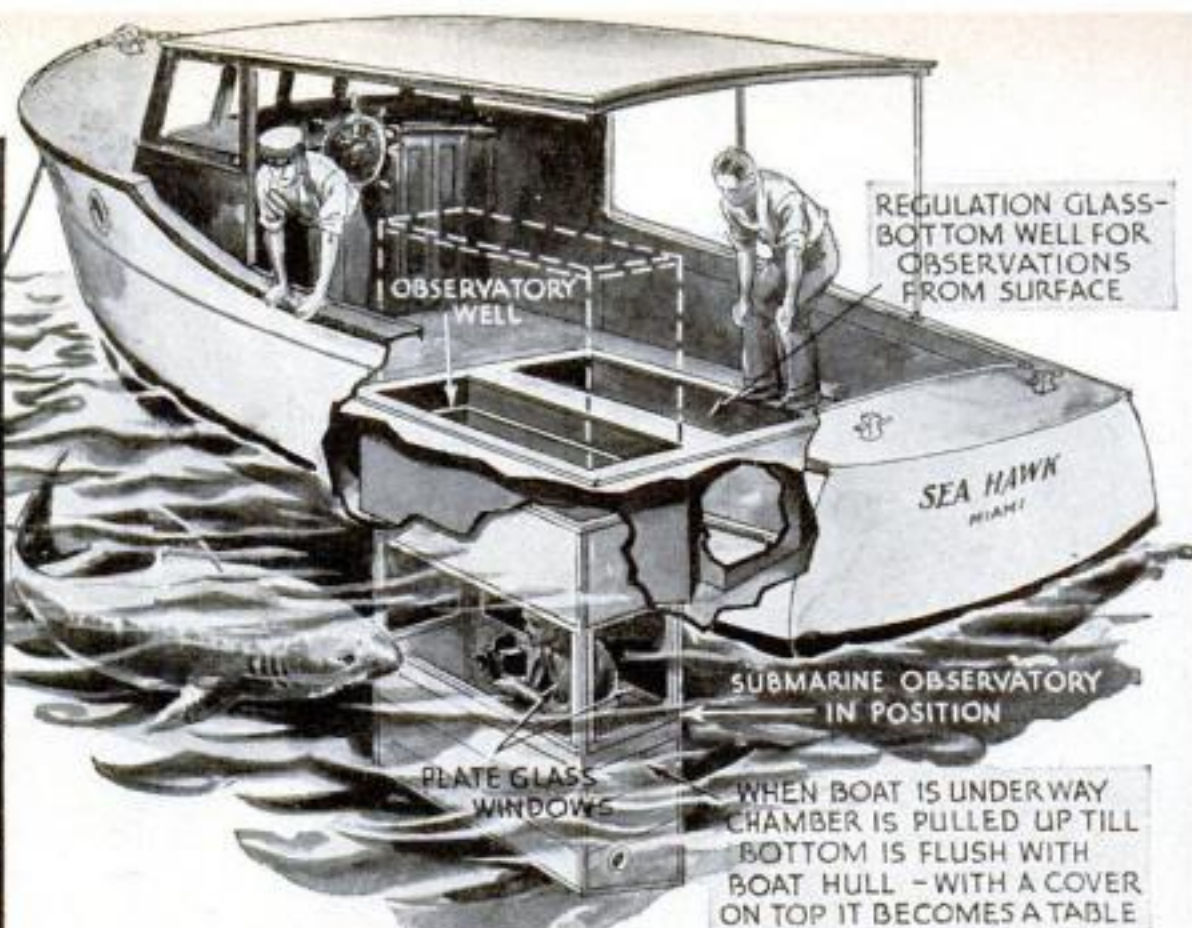
A fire extinguisher lies on the floor conveniently near. Some who work regularly around the machine plug their ears with cotton, and others with their fingers, for the crash of the discharge is like that of a siege gun. Just before each electric blast, an auto horn sounds raucously to warn everyone within earshot that it is coming. I watched the generator put through its paces. A thick copper wire was placed between the terminals. Crash! The wooden floor shivered. When I withdrew my fingers from my ears, echoes were still reverberating through the great shop. The copper wire had vanished in a flash and a puff of smoke.

A two-foot piece of hard maple went off like a bomb when the discharge hit it. Splinters flew. The largest piece of the block to be found measured about three inches long. Ozone, driven into the pores of the wood by the electric spark, could be smelled as it leaked slowly out.

When natural lightning hits a tree, McEachron said, the wood is similarly shattered. Explosive pressure, generated as the spark passes through the material, is responsible. If the discharge enters the tree, the whole trunk is smashed; if it runs along near the surface, long slivers of bark are knocked off.

A two-foot model of a frame house was sacrificed to the man-made lightning bolt. Paper sheets pasted over windows and doorway represented panes of glass. A wire led from the generator to the chimney of the model house, sim- [\(Continued on page 114\)](#)

BOAT OBSERVATORY FOR MARINE STUDY



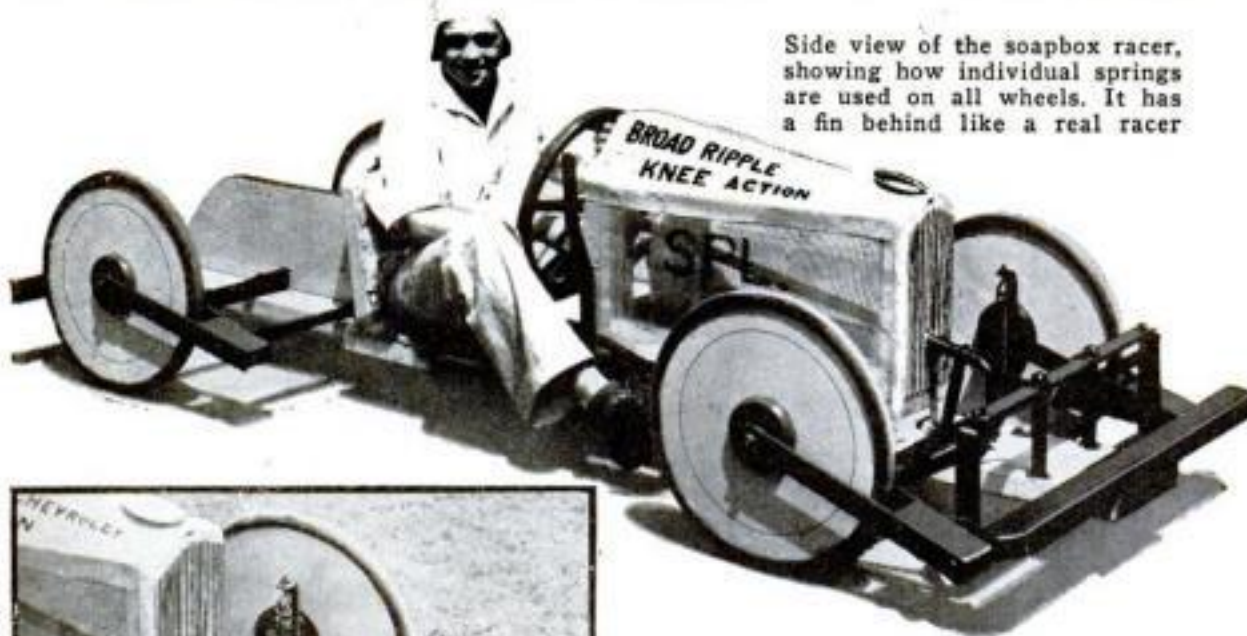
Left, the submarine observatory before mounting in the well provided for it in the motor boat. The drawing at right shows how it appears when lowered into the water to permit the study and photographing of marine life. A glass bottom and wide windows give ample vision

To study and photograph the floor of the ocean between Florida and the Bahamas, and its aquatic life, a Miami boat owner has fitted his cabin cruiser with a submarine observatory that can be dropped through a hole in the bottom of the boat. The underwater chamber is seven and one-

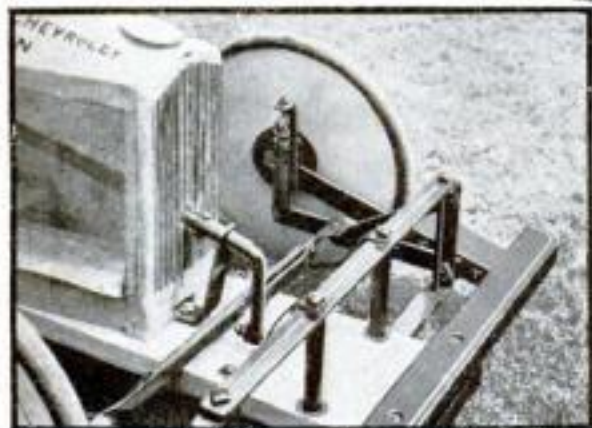
half feet deep and is large enough to admit two persons comfortably. Constructed of heavy timber and coated with waterproof paint, it is fitted with a glass bottom and the sides are encircled by wide windows. The observatory is submerged by opening a valve in the side near the bottom and flooding the whole chamber with water, which is pumped out when the chamber has reached the desired depth

and has been clamped in position. It is lifted into the boat again by means of tackle. In this position the chamber conforms to the curve of the boat's bottom to eliminate possible drag, while its top meanwhile is provided with a fiber-board cover to serve as a table. By means of this device, it is believed, observations and photographs can be made in places not easily accessible before.

HOMEMADE RACER BOASTS KNEE ACTION



Side view of the soapbox racer, showing how individual springs are used on all wheels. It has a fin behind like a real racer



Close-up of the front of the car, showing the mounting of the plank frame on spring actions

USING materials found for the most part in the cellar and yard of his home, a twelve-year-old Indianapolis, Ind., boy, with occasional aid from his father, has built himself a miniature automobile that, in one respect at least, is a step ahead of present day standard American cars. Where

factory-built automobiles boast of "knee action" on the front wheels, the boy's car has an independent spring for every wheel. The springs used were salvaged from a porch swing. Tired with sections of rubber garden hose, the plywood wheels run on roller bearings cut from a bar of steel. This bar of steel, incidentally, represented the only expenditure for materials, costing fifteen cents. The motive power is gravity, the car being used on long hills. The hood is made of reshaped oil cans and fly screen, and the single seat is upholstered with home-tanned rabbit skins. The car recently competed in a race at Detroit against home-made miniature cars from all sections of the country.



BOAT BUILT IN ATTIC PRESENTS A PROBLEM

WHEN A Newark, N. J., motor-boat enthusiast completed the building of a twenty-one-foot cabin cruiser in his attic, after two years of spare-time work, he discovered he had provided no means of getting the finished craft out of the house. He finally found a solution to the predicament by removing a section of the attic wall. A gang of riggers, setting up a boom in the back yard, lowered the boat from the aerial shipyard and transported it to a stream.

"TRUTH CHAMBER" DESIGNED TO WRING CONFESSIONS FROM CRIMINALS



A "TRUTH CHAMBER" recently devised by a New York criminologist is expected to wring confession of crime from a prisoner by compelling him to study his own features as he replies to a steady barrage of questions. It is a square cubicle with four mirrored walls. A battery of variously colored lights, suspended above the prisoner, plays upon him as he sits in the middle of the chamber. In the mirrors of the "truth chamber" he is able to note any suggestion of uneasiness in his manner or expression, and by changing the light from white to green or blue, detectives make him look worn and haggard. Convinced at last that his face and movements have already convicted him, the prisoner, the inventor believes, will confess.



ARM CLAMP HOLDS LIGHT

A MAN working in the dark may keep a flash light focused upon the job by means of a recently marketed holder. This consists of two elastic bands and two metal clips that are snapped on the flash light barrel. A non-elastic strap permits it to be held in other positions.

NEW TARGET SHOWS DIRECTION OF SHOT

TO ELIMINATE the confusion that results in rifle matches when wild shots strike the wrong target, a system of double targets has been devised which determines the direction from which the shot was fired. The face of the new target is the usual sheet of cardboard imprinted with the familiar bull's-eye and concentric rings. Nineteen inches behind this is placed a sheet of blank cardboard. By means of the holes made in the two sheets of cardboard, the position of the marksman who fired the shot can be accurately determined. The



double targets were used in the .22 caliber competition in the recent national championship matches at Camp Perry, Ohio, and are said to have been a success.

DIVINING ROD FINDS OLD WAR RELICS



This photograph shows the electric "divining rod" being lowered into the waters of Lake Ontario in search of relics of the War of 1812. The pumpman holds a cannonball recovered by a diver.

AN ODD use for an electric divining rod of the type used by mining prospectors was found recently, when old cannon and shot were recovered from the floor of Lake Ontario off Fort Niagara, N.Y. With the portable divining rod partially submerged, the recovery crew floated over the surface of the lake on a raft until the rod indicated the presence of metal. Once located, the desired objects were recovered by a diver. The old guns and solid shot are relics of the War of 1812 and are wanted for a restoration of Fort Niagara.



BRUSH IS PART OF TUBE

RUBBER CEMENT can be applied and spread in one operation with a brush attached directly to the neck of a newly invented tube container. The bristles are molded into the metal of the tube and cement squeezed from the tube flows through them. A tall cap fits over the brush and screws on the neck of the tube, keeping both the contents and the brush from becoming hardened by exposure to the air when not in use.

NEW LIFE-SAVING BOAT CAN BE CARRIED BY ONE MAN

A QUICK-ACTION life-saving device recently tested can be launched or landed in breakers that would swamp a life-boat. Resembling an ordinary surf board, it is built of mahogany for durability, but its hollow center makes it light enough to be carried under one arm. While sufficiently bouyant to support ten men, the board is intended to hold only a rescuer and a rescued person. The life saver sits and propels it by splashing his hands paddle-wise in the

water. The rescued person is placed in a prone position upon the board and brought to shore.



Left, new life-saving device made of hollow mahogany and so light one man can carry it. Above, the strange craft bearing a rescued person and an operator who propels it by paddling with his hands



MINERAL SPECIMENS SERVED AS FOOD



The food served at this meal consisted of remarkable mineral specimens that were shaped like steak, bacon, potatoes, and cream puffs

EVEN a person who boasts that his digestion is so strong that he can eat nails would have hesitated to partake of the rare "meal" served at a recent mining exhibition at Los Angeles. So far as the eye could tell, the food included a T-bone steak, bacon, baked potatoes, squash, cauliflower, cream puffs, mixed pickles, salt and pepper. Actually the tempting meats, vegetables, and condiments were mineral specimens resembling familiar foods in shapes and colors.

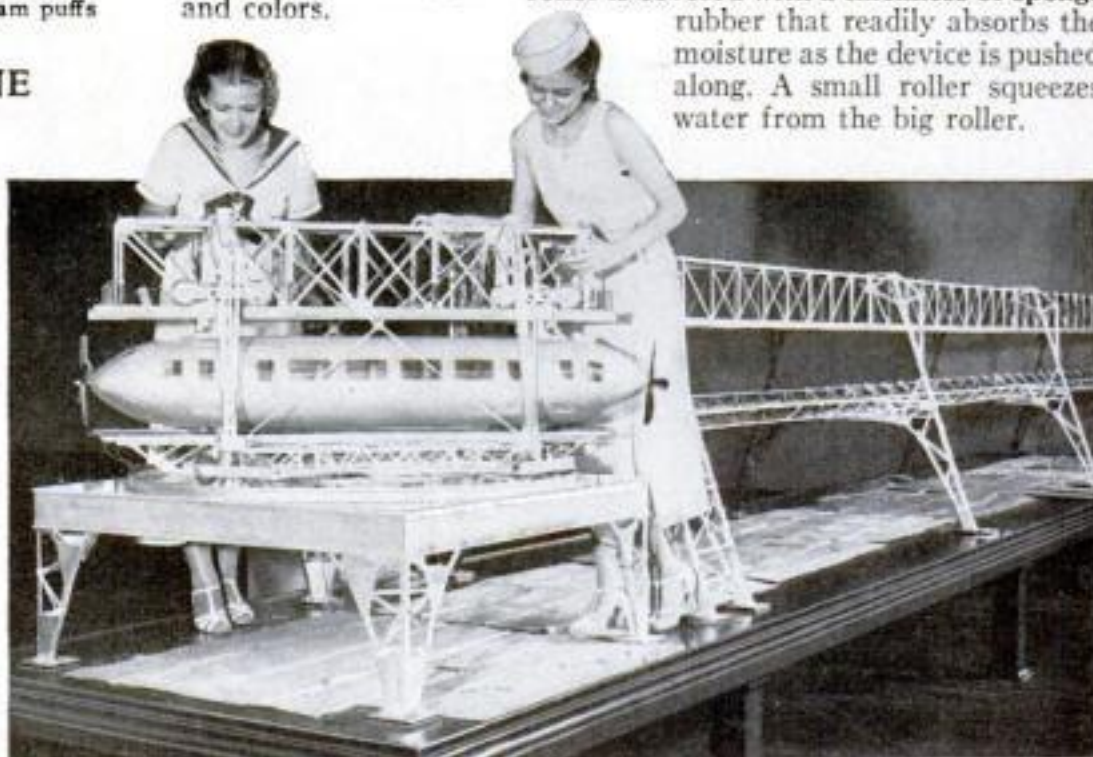


BLOTTER ROLLER DRIES UP TENNIS COURT

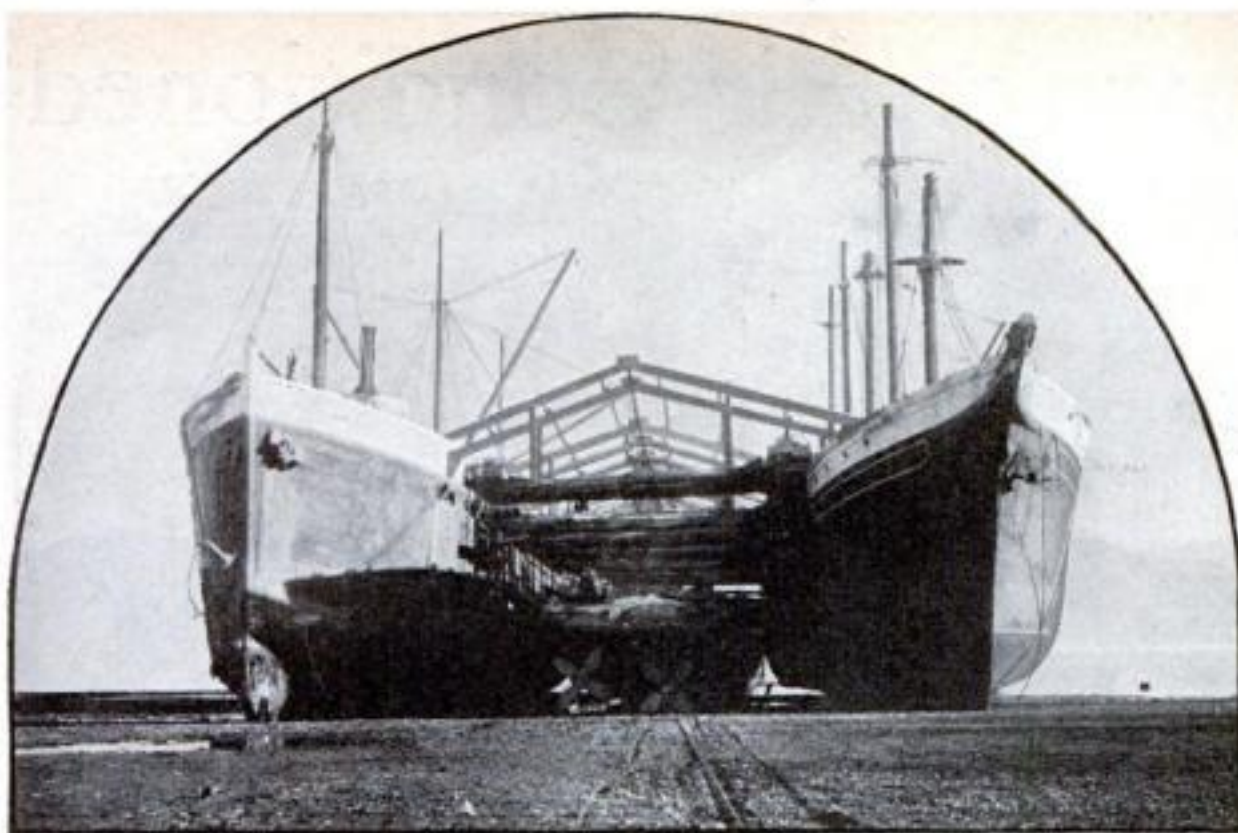
COMPLETE break-up of tennis matches or other games by sudden showers is prevented by the invention of a blotter roller that dries up a court or other turfed playing field as soon as the rain ceases. The roller is covered with a thickness of sponge rubber that readily absorbs the moisture as the device is pushed along. A small roller squeezes water from the big roller.

MODEL OF UNUSUAL RAIL PLANE EXHIBITED IN THIS COUNTRY

A TURNTABLE that looks and operates like a drawbridge is included in a model, now being exhibited in this country for the first time, of an elevated structure for a 200 mile-an-hour rail plane. The unusual type of transportation is the invention of a Scotchman, and a full-sized car and section of supporting structure were demonstrated to engineers in Scotland recently. The car, built in the shape of a cigar to keep air resistance at a minimum, is suspended from wheels that run on a single overhead track. Front and rear propellers are expected to drive it at speeds not before equaled by any form of rail transport. A rail beneath the car acts as a guide to keep it from swaying. Its cost of operation is estimated at ten per cent that of present railways and on account of several other advantages it is said that it will, if put in use, enable railroads to meet bus competition and other forms of transportation.



This model of a streamlined rail plane is now being exhibited in this country. It is driven by two airplane propellers, runs on a single track, and has a supporting guide rail beneath it



UNUSUAL FEAT RAISES TREASURE SHIP

IN ONE of the most remarkable salvaging operations ever undertaken, the steamer *Islander*, believed to contain \$4,000,000 in gold, has been lifted from her resting place in 365 feet of water and placed high and dry on an Alaska beach. Divers reached the sunken steamer and attached cables from a

boat on the surface. With these lines the treasure ship was lifted and towed to shallow water. There another surface ship was joined to the first by means of heavy trusses and cables were suspended from the bridge thus formed. With these cables the ship was brought to the surface and beached.

SWIMMERS PEPPED UP BY WHIFF OF PURE OXYGEN

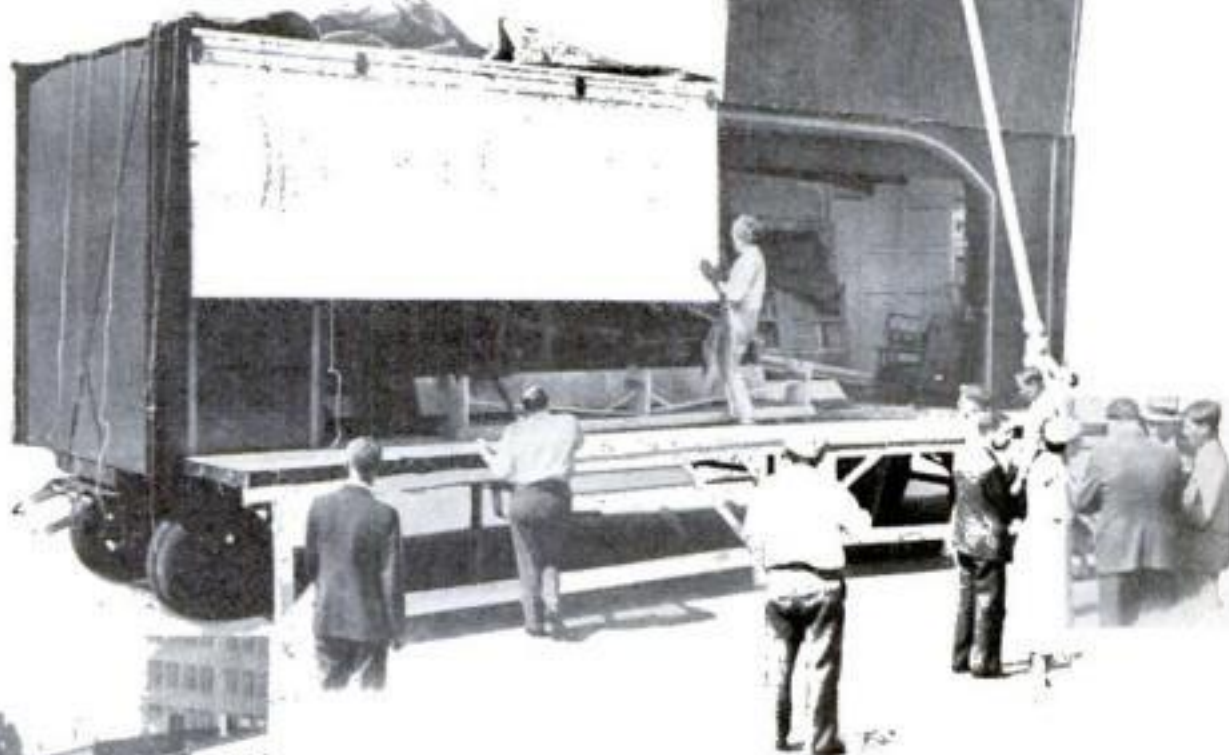
ATHLETES were transformed into super-swimmers in a recent test at Springfield College, Mass. Each of the swimmers was given two deep breaths of pure oxygen before he leaped into the water. Holding their breath until they had entered the tank, eleven of the seventeen youths taking part beat their own previous records in a 100-yard dash through the water.



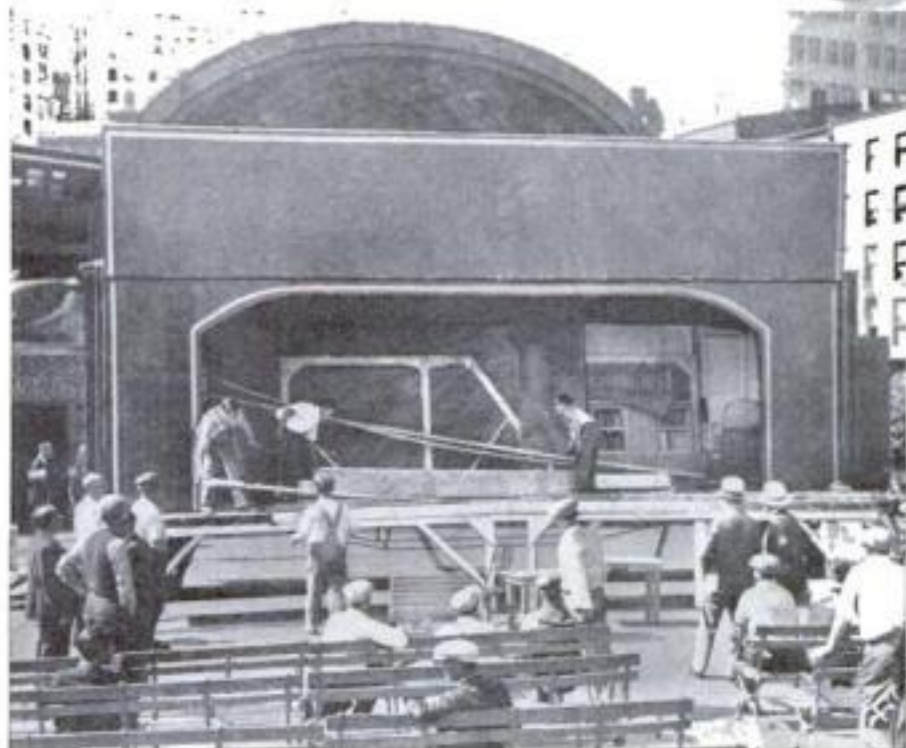
A swimmer inhales pure oxygen before taking part in a race to test its stimulating power

TRAILER CARRIES FOLDING THEATER

PLAYS are given in the open air in New York City by a traveling theater contained in a single truck trailer. Towed to a park, the stage is unfolded in a few minutes. The lower half of one side of the vehicle drops and becomes the front section of the stage. The upper half, swinging up, gives the front of the theater the appearance of height. On the other side of the trailer, a single panel lowers to form the rear of the stage. The stage is thirty feet long and, when fully opened, twenty feet deep. The traveling theater, which was designed for the Department of Public Welfare to relieve unemployment among actors, is equipped with electric lights and loudspeakers for the benefit of the open-air audience.



Above, lifting sides of the trailer to form the proscenium arch of the outdoor stage. Left, arranging the settings. Performances are given in the city parks

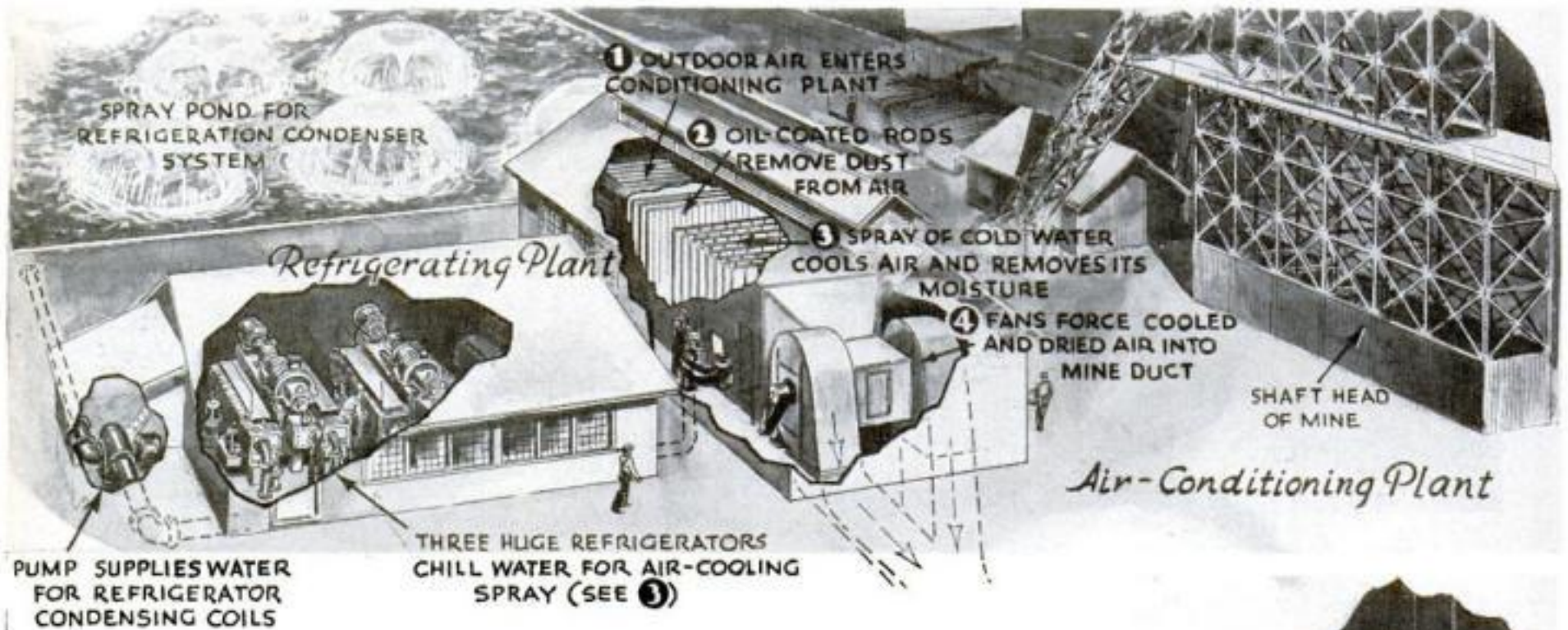


NEWEST AUTO GADGET SAYS, "THANK YOU"



COURTESY lights mounted on an automobile enable the driver to flash a "Thank You" message to other motorists. The lights, attached to the radiator cap and to the rear of the car, are operated by a control on the dash or steering wheel. Their widespread use may tend to bring about better road manners by the touring public, thus helping to reduce the number of accidents.

Deepest Mine to be Air-Conditioned



TO STIMULATE production of gold, African natives, who now swelter in the stifling heat and humidity of a mine a mile and a half deep, are to be provided with cool, invigorating breezes. Robinson Deep, the deepest mine in the world, is to be air-conditioned. The stupendous job will require the largest conditioning plant ever assembled. One of the most valuable operations in the famous Rand district, Robinson Deep has shafts that pierce the gold-bearing quartz plateau for 8,380 feet, the greatest depth to which man has ever descended. Into the main shaft, if it were straight and big enough around, could be dropped seven Empire State buildings, one on top of another, and only the mooring mast of the seventh building would show above ground.

Present temperatures in the lower levels of the mine range from 100 to 120 degrees. The humidity never falls below ninety per cent and often reaches virtual

saturation. The excessive heat is due in part to the rise in atmospheric pressure as descent is made. Every 1,000 feet increases the temperature five degrees. Heat is further intensified by rock which grows hotter the nearer the core of the earth is approached. Frictional heat from machinery and body heat from the miners tend to raise the temperature. The humidity is caused by seepage from the rocks and by the necessary wetting down of dust during drilling and blasting operations.

The actual conditioning of the air will be done on the surface. Here the air will be drawn through a spray of ice-cold water which will cool it and condense its moisture. Twelve-foot fans will drive 400,000 cubic feet of conditioned air into the main shaft of the mine every minute. A large sloping tunnel will carry this air into the shaft 100 feet below the surface. Cold water for the cooling and dehumidifying spray will be supplied by a triple bank of immense centrifugal refrigerating machines.

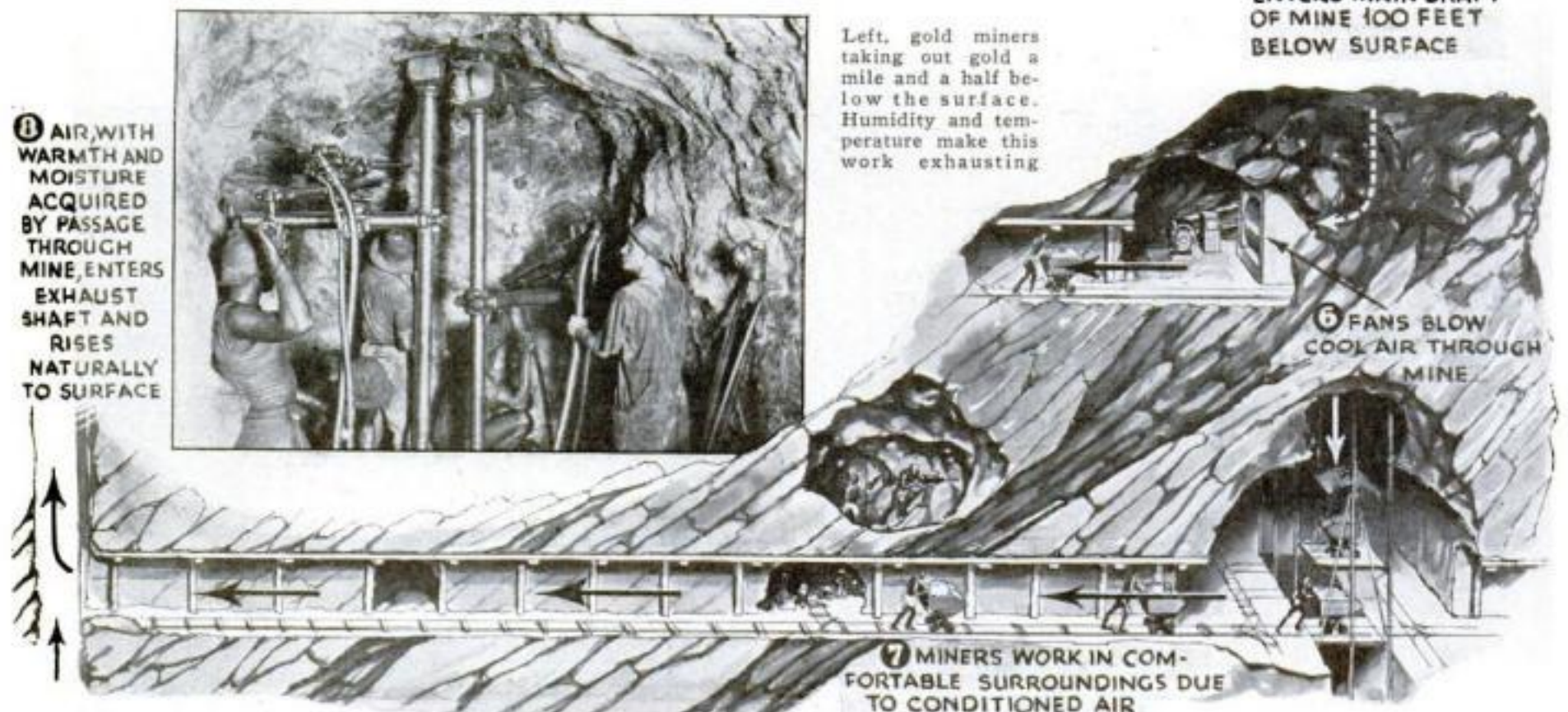
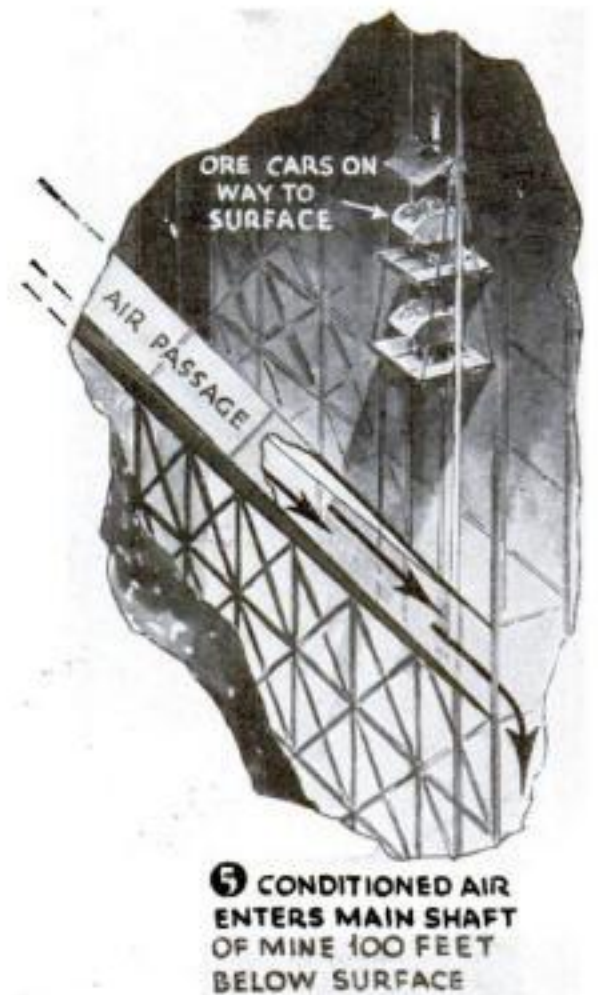
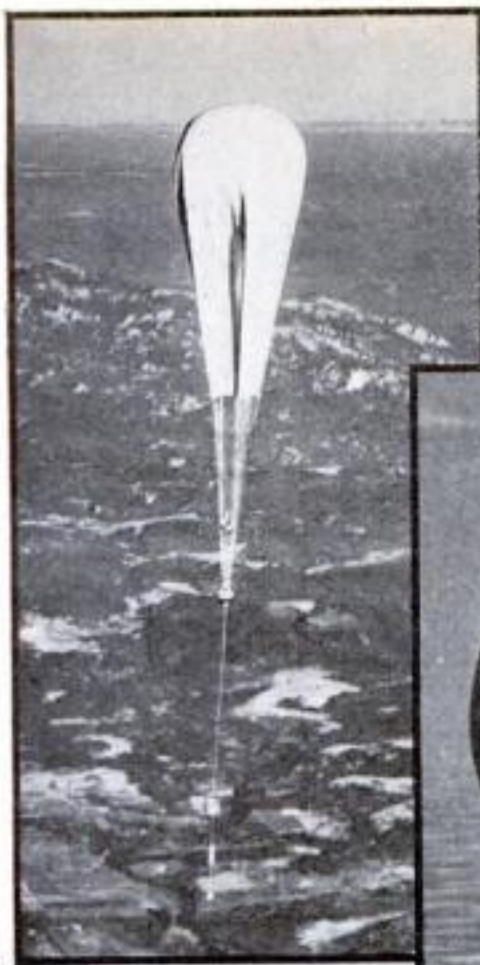
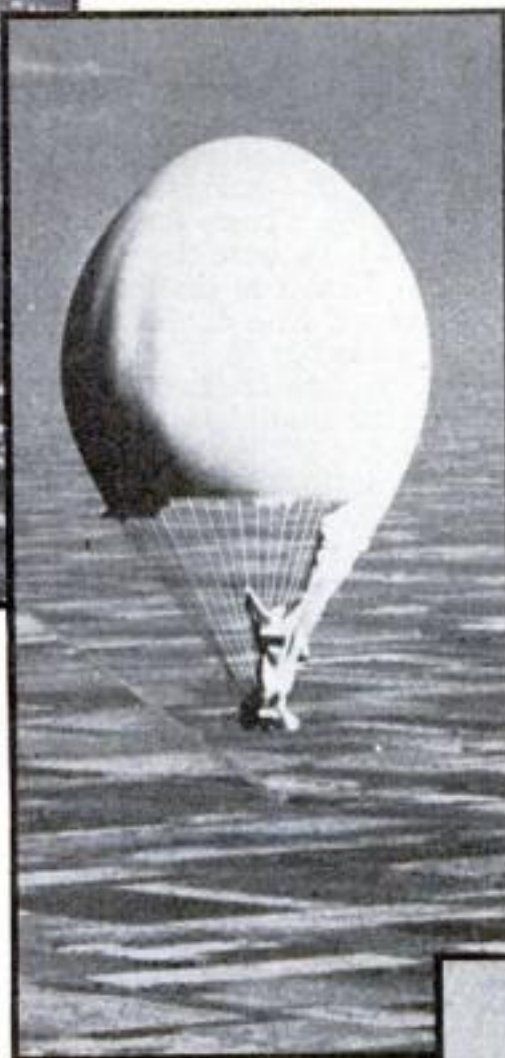


Illustration shows the various steps in cooling and drying the air to be pumped down into the world's deepest mine

Pictures Tell Story of Americans' Stratosphere Flight



1 Above, stratosphere balloon rising over Black Hills at start of flight. The picture was made from an Army plane



2 Right, remarkable view of the balloon as it fell with fabric torn and piled on top of gondola during its last 7,000 feet of fall

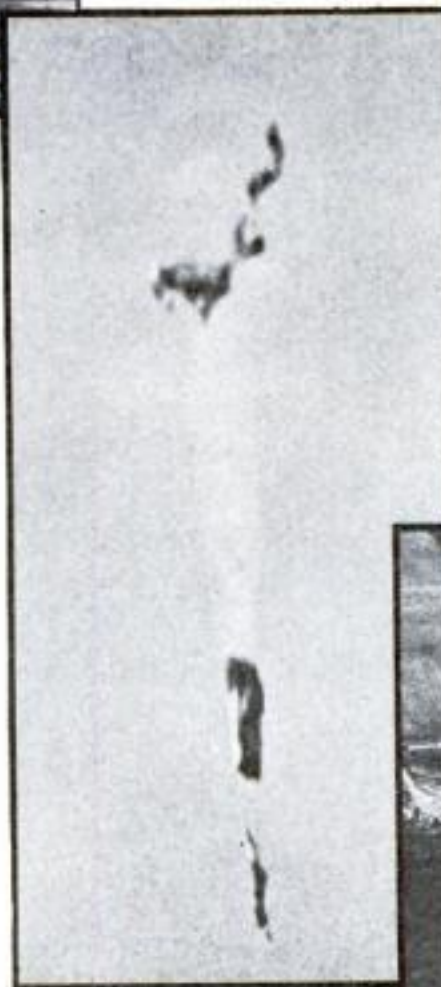


Above, loading instruments into the balloon's gondola before the take-off. At upper right is the spectrograph

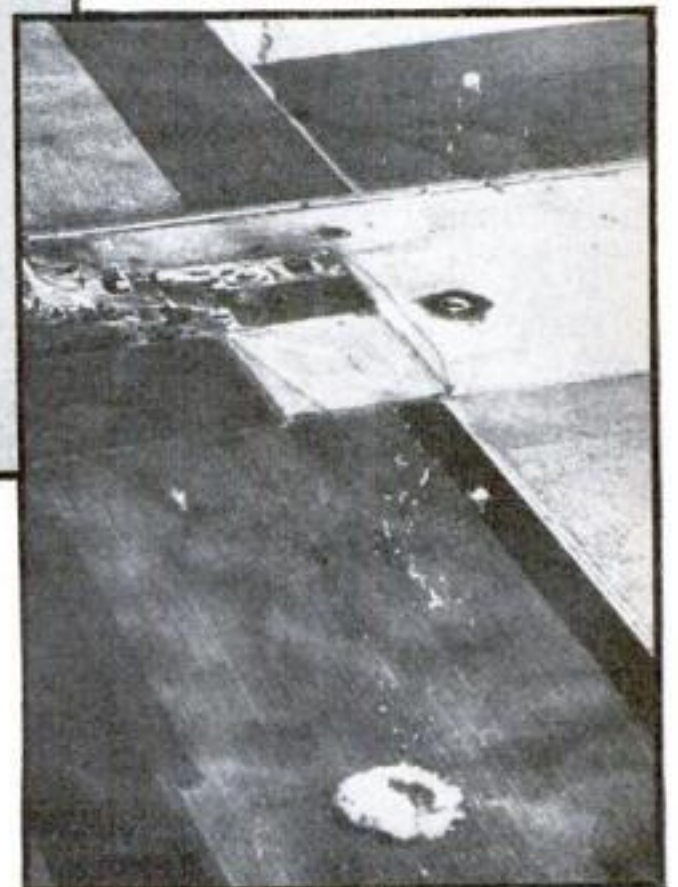


Cut loose from the falling balloon, this spectrograph swung to earth upon its own chute without injury

THREE men in a ball-shaped gondola hurtled down from the stratosphere toward a Nebraska cornfield trailing behind them the flapping wreckage of their balloon. Helpless to aid them in their desperate plight, an observer in an Army airplane trained his camera on the plummeting bag. The result was the remarkable series of photographs reproduced here, first of their kind ever taken, showing the dramatic escape of the men and the crash of the gondola. The purpose of the expedition into the stratosphere, jointly undertaken by the U. S. Army Air Corps and the National Geographic Society, was to explore heights never before reached by man. The biggest balloon in the world carried the observers safely to an altitude of more than eleven miles. Then they radioed that they were in trouble and descending. A rip had appeared in the bottom of the bag. Bouncing up and down at the mercy of stray air currents, the balloon went to pieces. At 5,000 feet, it split wide open. With nothing left to support it, the metal gondola plunged down like a bomb. Three thousand feet from the ground, Captain Orvil A. Anderson leaped from the projectile with his parachute. Capt. Albert W. Stevens lingered to cut loose one of the most valuable scientific instruments, a recording spectrograph, allowing it to drop on its own parachute. Then he struggled three times to get through the porthole of the gondola against the air pressure, succeeding at 2,000 feet. Major Kepner followed him with not a second to spare. By their lucky escape, the men missed the fate of three Russian stratosphere explorers, who perished in their gondola when it crashed to earth after a thirteen-mile ascent last winter. Anderson, Stevens, and Kepner landed safely, without even a scratch. Moreover, their perilous flight was not made in vain, for priceless records of the sun's rays made by the spectrograph were recovered.



3 Above, what is believed to be the only photograph of the stratosphere balloon bursting. The picture was taken an instant before the crash occurred



4 Right, the gondola crashes to earth, raising a ring-shaped cloud of dust. Two of the observers' chutes may be seen in air

• NATURE IS College



The unique institution of learning, the College on Wheels, travels in big buses like the one shown above. Each bus accommodates thirty-five persons. In this way 700 students went to nature for information

ROLLING universities, heading east and west during the past summer, have been substituting buses for books in an absorbing experiment in education.

Known as the Omnibus College, the motorized classrooms have carried more than 700 students on a quest of first-hand information. Geology classes have visited the sites of unusual rock formations; sociology groups have studied in city slums; botany students have collected plants along the roadsides and zoology classes have studied wild life in the open. In all, the blue and yellow buses carried the 700 students and forty professors 12,000 miles during the summer months.

The dozen machines that made the eastern tour started from Wichita, Kan., swung south through Arkansas, Tennessee, Mississippi, Louisiana, and Florida, then north through Alabama, Georgia, Virginia, Washington, D. C., Pennsylvania, New Jersey, and New York to New England and Canada. Around the Great Lakes, they headed home, stopping at A Century of Progress Exposition at Chicago before cutting across Iowa, and Nebraska to Wichita.

At the same time, through the far west, a second expedition of big buses was taking almost 250 students and professors through Colorado, New Mexico, California, Oregon, Washington, Idaho, Utah, Wyoming, South Dakota, and Iowa to Chicago and back to Wichita. A third expedition, traveling in large automobiles in place of buses, followed the first upon the Eastern tour, with sixty students on a seven weeks trip.

The Omnibus College, was, at first, a unique institution with nothing like it in the world, but this year one other university sent out an omnibus trip of the same kind. In 1922 Dr. William Marion Goldsmith, Professor of Biology at the Municipal University of Wichita, Kan., decided that his students needed some-



Each section of 150 in the traveling college has a cafeteria that is set up on the camp site before the students arrive. The photo above shows the restaurant in process of getting ready for business

This article gives you all the facts about the world's strangest school. With 700 students, it travels 12,000 miles that take it into twenty states

By
**HELEN
CHRISTINE
BENNETT**



A street of tents for the College on Wheels. Each tent contains twenty beds and is lighted with electric lamps. A separate tent encloses a shower, ready for use night and morning

TEXTBOOK FOR *on* Wheels

thing fresher than laboratory specimens preserved in alcohol. He took four boys in a secondhand flivver over what was to be the first Omnibus College route. His four students were so enthusiastic that the next year a bus was bought and thirty-five students enrolled. Miss Martha Foster of Tulsa, Okla., asked to go along. After that the number of co-eds increased rapidly. In 1934, eighty-five per cent of the students were girls.

Even through the years of depression, the Omnibus College rolled its happy way. Its graduates of almost 7,000 persons represent forty-six of the forty-eight states. Its studies are real and serious. The "credit hounds," as Dr. Goldsmith calls those who take their work seriously, may earn three credits per subject—if they pass the professor's tests. During 1934, nine colleges directly co-operated in staffing the Omnibus College, each one sending one member of its own faculty to act as a professor. Monmouth College, Monmouth, Ill.; State Teachers College, Greeley, Colo.; Oklahoma College of Agriculture and Mechanics, Stillwater, Okla.; Oklahoma City University, Oklahoma City, Okla.; Utah Agricultural College, Logan, Utah; University of Arkansas, Fayetteville, Ark.; University of Wyoming, Laramie, Wyo.; Drury College, Springfield, Mo. thus joined with the Municipal University of Wichita in fostering a learning which depends on buses rather than books.

This is a self-contained, almost self-sustained college. It sleeps them and eats them and learns them as it rolls along.

Into the National Military Park, near Vicksburg, Miss., rolled a bright yellow and blue van. The van turned out three young men, and a private car that followed turned out five more who at once began unloading. As if by magic neat khaki tents were set up row upon row, three-quarter sized bedsprings with foot-high iron legs were placed in the tents, two rows of ten each to each tent. Mattresses, taken from waterproof canvas covers, went on the springs and last, out from their tarpaulin wrappings, came a pair of blankets for each bed. Then wires were strung and electric light bulbs attached above the beds.

It takes an hour to make or strike camp. To avoid delays in travel and crowding traffic, students are divided into groups of 150, each known as an autocade. Each autocade is highly organized, with a director, who is usually a man, a dean of women, a manager of the baggage van with two assistants, a second huge van which is a cafeteria with full equipment and carries a man-



Nature provides the class room and the material to be studied by the scholars in the Omnibus College. Here a class in botany is seen gathered around a professor who is lecturing



The cafeteria in action. So adequate is the equipment and the arrangements, that all the members of an autocade can be fed at the camp lunch room without crowding or delay



View of the Omnibus College camped out for the night. An advance guard chooses the site and gets the tents up before the students arrive. The camp looks elaborate but the actual work of making or striking camp requires only an hour.

ager and two assistants, four buses with a capacity of thirty-five persons each, driven by young men who also hold college degrees, and six passenger cars carrying professors, dean, director, and a master mechanic. Each autocade travels a day apart from the succeeding one. The buses hold no formation on the road; they simply get there. To make life pleasant for students and professors, each autocade is supplied with an extra-equipment outfit. Before the students leave camp, the extra outfit is on its way to the next stop. Tents are ready and food hot when the weary travelers arrive.

Most stops have organized camping facilities with showers, toilet, a laundry, and a general meeting place. The usual route was varied in 1934 and included Montgomery, Ala., and Atlanta, Ga., two cities that could offer no camp sites. Omnibuster scouts secured the use of two pleasant high school yards, and the schools willingly opened their doors and gave the use of gym showers and lavatories.

At Gatlinburg, Tenn., the Omnibusters pitched camp at the foot of Mount La Conte. Twenty-three ambitious young persons discounted the black clouds and started a hiking trip to the summit. The heavens opened and the deluge fell. Thunder and lightning played. The head baggage man, assistant football coach at Nebraska University, was struck by lightning, passed out and stayed out for an hour. Eight tents were blown over. For three hours it poured. When the twenty-three hikers, soaked to their skins, finally reached camp it was to find everyone in action. Wet clothes were piled in baskets and tents struck. The Omnibus College was going away from there to find a dry spot. In an hour they were on their way; in four they had found a new camp, had pitched the tents, and were settling to dry out.

The minute the students arrive at camp, cars from dry-cleaning and laundry establishments drive in to collect clothing and return it within twenty-four hours—all this pre-arranged by Omnibus management. Then the girls who wash and iron

their own, except bed sheets, which are sent out in the morning and on the beds that night, get to work in the laundry rooms.

All these and a thousand other details are faithfully recorded in signed articles by the members of the class in journalism and are printed in "The Omnibuster," an eight page newspaper with a good format, which is published in all the major cities, Pensacola, Washington, New York, Boston, Quebec, and Chicago, and continued all the year from Wichita, carrying news of the winter activities of the students. The arrival of a new copy of "The Omnibuster" is an event of major importance. It is the connecting link between students, not only of the one autocade or expedition, but of the western and eastern tours.

As the buses roll, the changing trees and flowers keep the botanists busy. Fifteen members of the second autocade are enrolled for the biology course directed by James E. Cribbs of Drury College, Missouri. Dr. Cribbs received his Ph.D. from the University of Chicago. The course is a study of the interrelationship between organisms, both plant and animal, and their environments.

"A trip of this kind offers an admirable opportunity for this kind of study," Dr. Cribbs says. "The Mississippi flood plain, which is first studied, offers some unique flora to the botanist. Following comes consideration of life on The Coastal Plain and the Gulf life. In the Great Smoky Mountains will be found the most diversified flora and fauna in the country. Going on up the coast the class will take up life on the sandy beaches and rocky coasts and in northern coniferous forests."

But the interrelationship between organisms both plant and animal and their environments which The Omnibus College does best with is the clean, fine comradeship of 450 Americans, well-bred and well-educated, who are traveling to study because they like it. Thirty-five to a bus, twenty to a tent, living nine weeks in close companionship, the Omnibusters develop into the best sports in the world. Their interrelationship is a beautiful thing to see and to be with.

HOW STUDENTS LIVE AND WORK IN THEIR TRAVELING UNIVERSITY

Left, two of the editors of the Omnibuster, official paper of the College, are at work on copy in an effort to meet the dead line. Below, a night view of the interior of one of the camp tents showing beds occupied



Above, the camp crew setting up one of the big tents—an easy job for these trained workers. Right, out in the sunlight, students enrolled in the College on Wheels get their botany at first hand



Tricks That Enable You to Take Secret Pictures



DUMMY LENS HELPS. On what seems to be the front of this camera is a large dummy lens and cable release to distract the subject's attention. The real lens is at the side and the man is taking a picture at his right

TRICKS used by press photographers and detectives come in handy when it is desired to snap unposed photographs of friends or members of the family. For such pictures photographers usually use tiny, easily concealed cameras. Despite their size, these midget cameras are surprisingly fast and accurate, and their wide angle lenses make the use of a range finder unnecessary. One of the commoner ways of screening a camera from the intended subject is to cover it with a handkerchief until the trigger is released. Occasionally the camera is carried in a vest pocket with the lens shielded by the wearer's coat. At the moment of snapping the picture, the coat is pulled back and the shutter tripped with the free hand. Cardboard cartons and even books sometimes serve as camouflage. With a carton, a hole is cut in one side and the opening covered by a hand until the picture is snapped. In preparing a book as a place of concealment, a cavity is hollowed out of the leaves and a hole just large enough to take the lens is cut on one cover as is shown in the illustration at the right.



CONCEALED IN A BOOK. The heart of a book is cut out, as shown above, and the camera placed in hollowed-out portion. A hole in the cover fits over the lens. It is used as is shown in circle



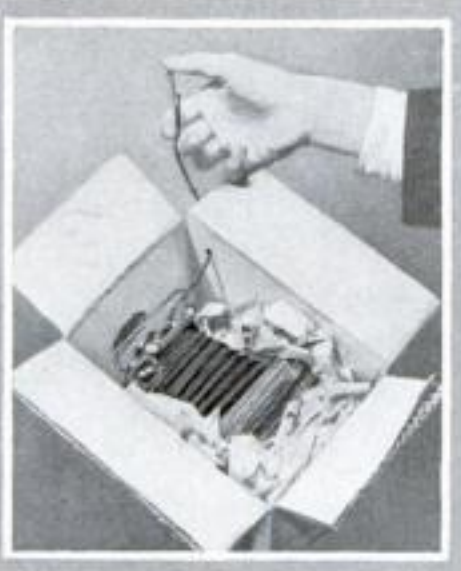
A CARTON WILL DO
Right, an innocent cardboard carton is carried by the photographer. He takes care not to cover the hole in its side as beneath it is the lens of a camera that is hidden in the carton. The whole arrangement is shown in the picture below



HIDDEN IN A POCKET. It is possible to get a secret picture by placing the camera in the vest pocket and flipping back the coat as shutter is snapped



SHIELDED BY NEWSPAPER. Above, a newspaper is being held between the subject and the camera. A hole in the paper admits light to the lens. The view above shows how camera is worked behind the newspaper





HOMEMADE WINDMILL BUILT OF ODD PARTS

A NORTH DAKOTA farmer recently found a way to pump water for his stock by using two oil drums and a few scraps from a junk automobile to build himself a windmill. Cut into halves, the drums are mounted in an upright position on an arm of an elevated turntable. The turntable rotates the vertical drive shaft taken from an old car. To this shaft, the differential and rear axle of the automobile are still attached. One axle shaft ends in a wood disk that operates the pump.

COWL ON MOTOR BOAT BOOSTS SPEED

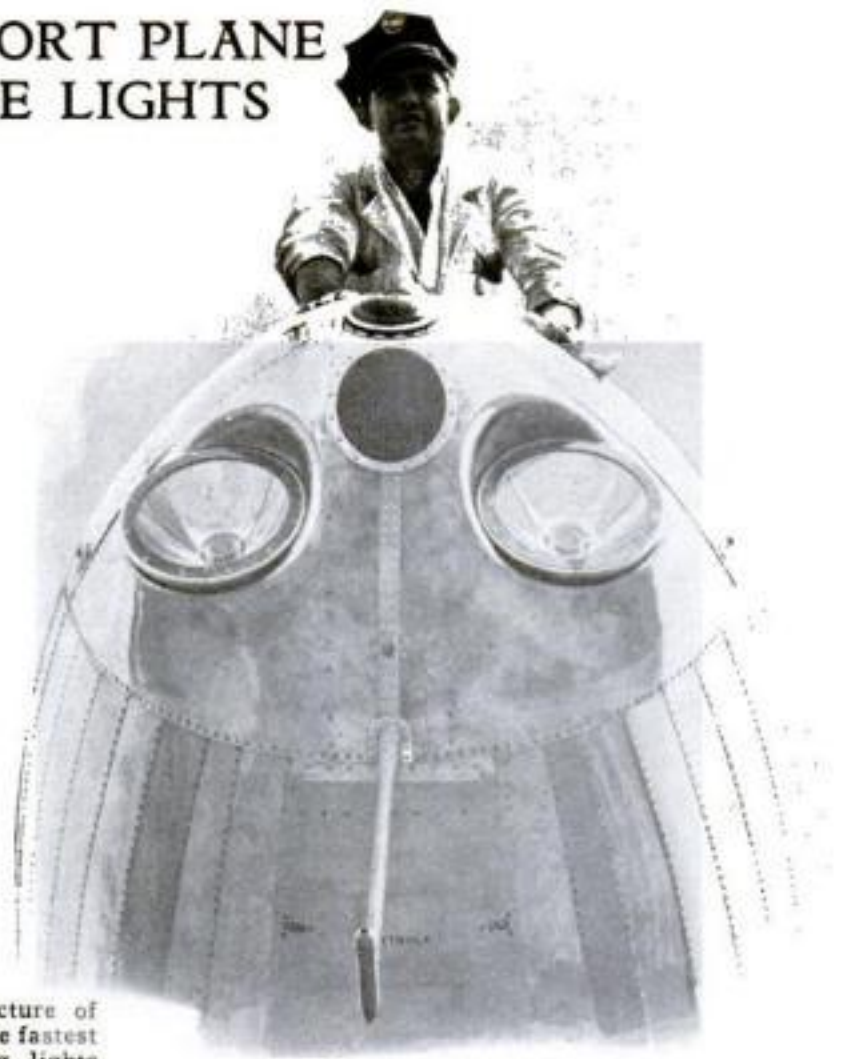


Streamlined cowl fitted on motor boat to increase its speed

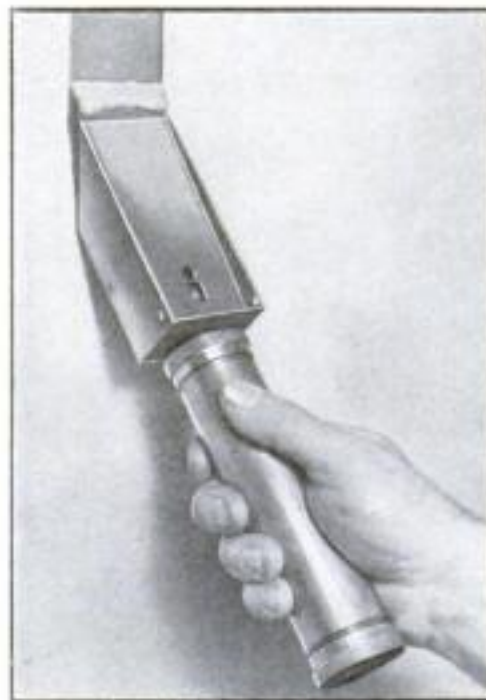
FAST TRANSPORT PLANE HAS EYELIKE LIGHTS

WITH its two eyelike landing lights, the forward tip of a new airplane looks more like the head of a sea monster than the nose of one of the fastest transport ships yet built. Maintaining an average speed of almost 200 miles an hour, the new plane will fly between New York and Los Angeles on a regular schedule of fourteen hours. The plane proved its speed and airworthiness in exhaustive tests before going into service. The fuselage of the ship is constructed of duralumin and the whole ship is streamlined to cut air resistance to the lowest point possible.

This remarkable head-on picture of new transport plane, one of the fastest built, gives view of landing lights



BRUSH WORKS LIKE FOUNTAIN PEN



A BRUSH that holds its own paint, as a fountain pen does its ink, has been devised by a New York inventor for home decorating, sign painting, and stenciling. As much as a pint of water color, enamel, lacquer, or varnish may be placed in the hollow handle. From there it flows by gravity to the felt tip during the user's up and down strokes. The flow may be stopped at will by placing the finger on a small hole serving as a control valve. The tip is discarded after each job.

Paint brush, at left, holds paint in handle and lets it flow as ink does in a fountain pen

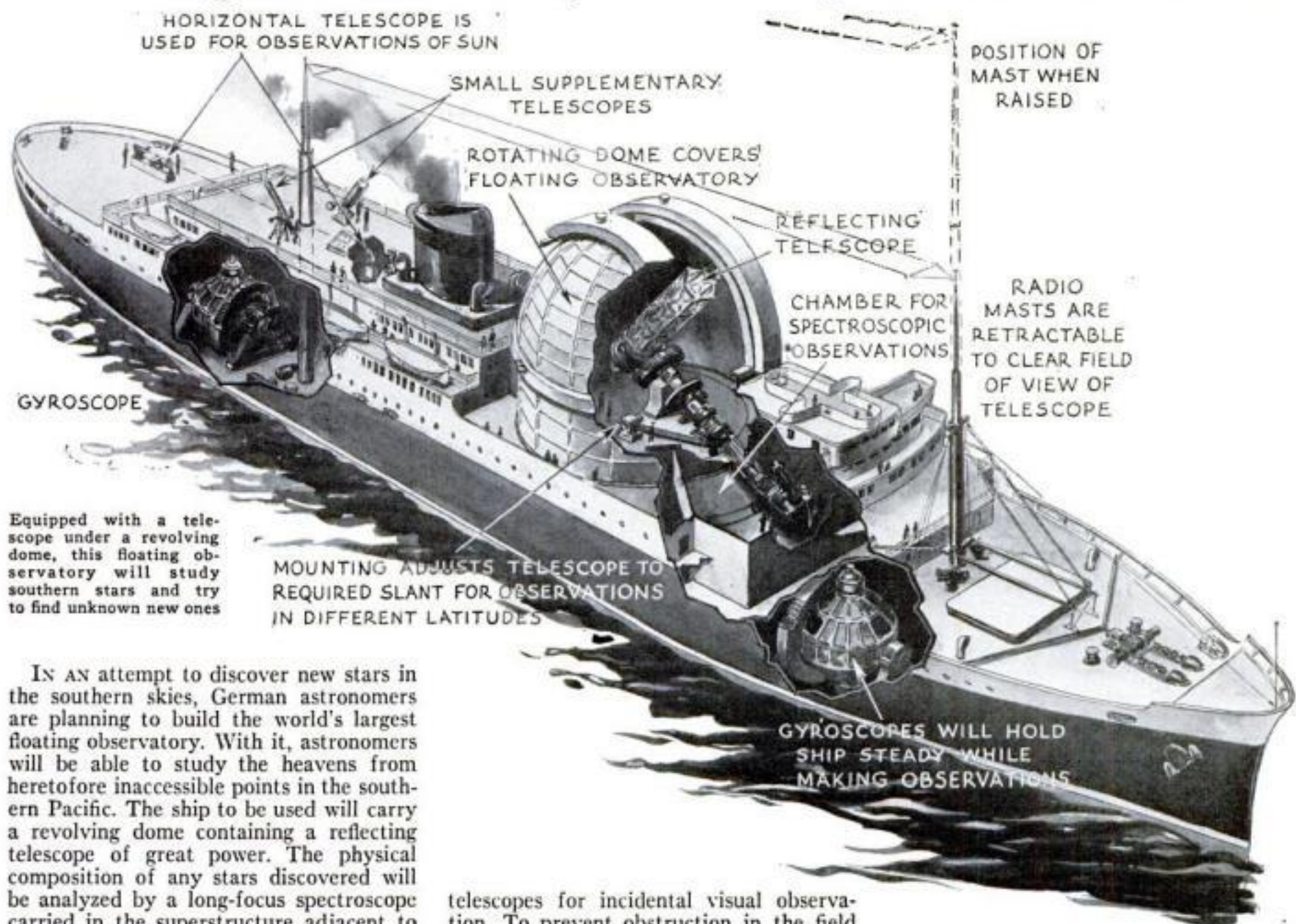


Two views of coil-spring clamps designed to hold car's license plates

CAR'S LICENSE PLATES HELD BY SPRING CLAMP

USING a new clamp, license plates can be attached to automobiles by a twist of the wrist. It consists of a small coil spring containing a metal pressure disk. One end of the spring wire is bent down through the center of the spring and terminates in a double loop. With the license plate held firmly against the bracket on the automobile, the loop is pushed through the rectangular slots in the plate and bracket, and the spring given a quarter turn, which secures the plates.

Floating Observatory to Study Southern Stars



Equipped with a telescope under a revolving dome, this floating observatory will study southern stars and try to find unknown new ones

IN AN attempt to discover new stars in the southern skies, German astronomers are planning to build the world's largest floating observatory. With it, astronomers will be able to study the heavens from heretofore inaccessible points in the southern Pacific. The ship to be used will carry a revolving dome containing a reflecting telescope of great power. The physical composition of any stars discovered will be analyzed by a long-focus spectroscope carried in the superstructure adjacent to the dome. Solar study will be made with a horizontal type of sun telescope to be installed on the after deck. The secondary mirror of this telescope will be located at the end of a special passage in the after housing. The astronomical equipment of the ship will be completed by two smaller

telescopes for incidental visual observation. To prevent obstruction in the field of the main telescope, the masts of the ship will be built of telescoping sections so they can be lowered out of the way. The problem of keeping the floating observatory on an even keel has been solved, organizers of the expedition believe, by making provision in the hold of the ship

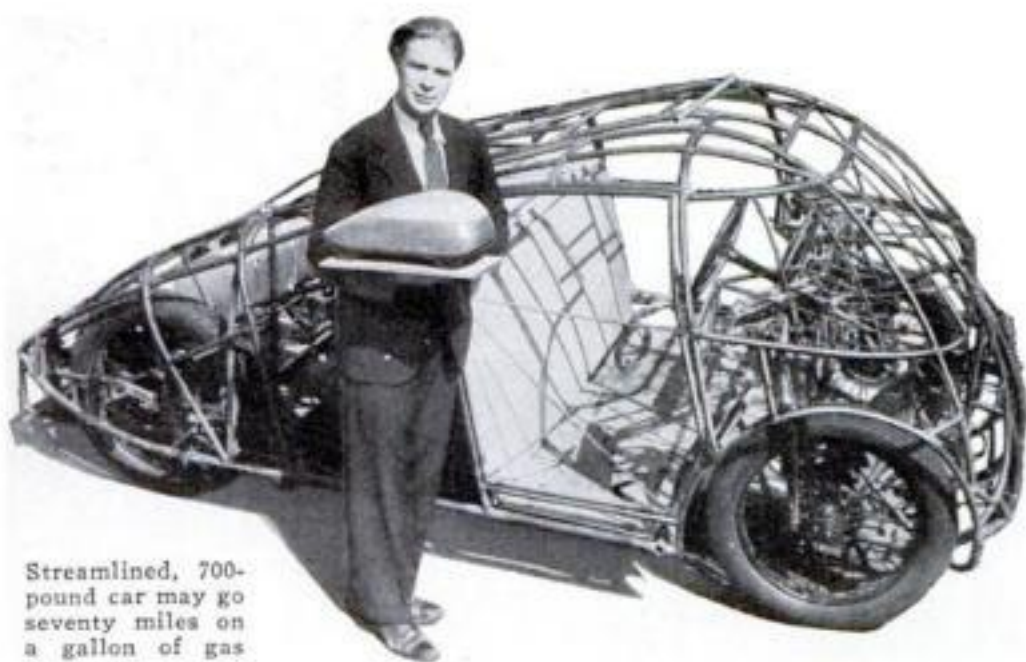
for two huge stabilizing gyroscopes. A powerful radio outfit will keep the ship in touch with the outside world during the cruise and also report to scientific bodies the discoveries and results of observations and discoveries.

ELECTRIC EYE GAGES HEADLIGHTS

DEFECTIVE headlights are spotted instantly by St. Louis police with a new testing device that measures glare by means of an electric eye. In the new device, as the electric eye is moved over the field illuminated by the headlight beams, it records on dials on the reverse side of the instrument the intensity of the light.



Police use this electric eye to gage the glare of headlights. Intensity is registered on dials on the back of the instrument

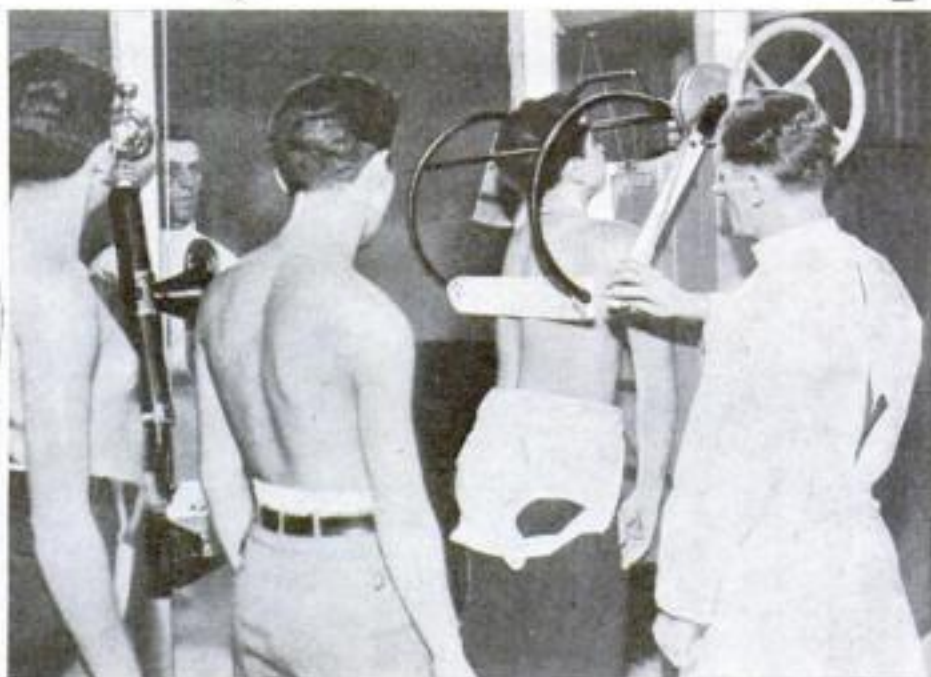


Streamlined, 700-pound car may go seventy miles on a gallon of gas

BIOLOGIST DESIGNS NEW 700-POUND CAR

POWERED by a motorcycle engine, a lightweight, streamlined automobile now being built is expected to travel sixty miles an hour and run fifty to seventy miles on a gallon of gasoline. This mileage is expected to be the result of the low wind resistance of the car and through the use of welded chrome-molybdenum steel tubes for the frame. This material will keep weight of the four passenger car to 700 pounds. The designer of the car is Dr. Calvin B. Bridges, California biologist.

Portable Outfit Makes X-Ray Pictures Cheap



Above, portable X-ray machine making pictures of schoolboys at the rate of four a minute. Left, ingenious device used in examining X-ray pictures

X-RAY pictures of the chest at the astonishing rate of four a minute, and at a cost of less than a dollar each, are made possible by a portable high-speed machine recently perfected. The secret of the remarkable speed and low operating expense lies in the use of paper film instead of more costly celluloid. Enough film

for 100 exposures is wound on a roll in a vertical cabinet and is easily fed into position before a standing subject. A band of cloth, held rigidly between two curved levers hinged to the top of the cabinet, holds the subject's chest against the device. The angle of these levers is measured automatically on a dial, indicating the thickness

of the subject's chest and thus the amount of X-ray energy required. The whole operation requires only fifteen seconds. Pictures, as soon as the roll has been exposed, can be developed in a portable tank that accompanies the apparatus. The pictures made in this way lack the clarity of celluloid film but this, their users say, is unimportant in preliminary examinations. School children in New Haven, Conn., have been X-rayed with the portable outfit at the rate of 600 daily. The machine is expected to prove particularly valuable in public health work and similar fields where speed and economy are essential.



BLADE IN SAFETY RAZOR CHANGED MECHANICALLY

BLADES can be changed instantly, in a new type of safety razor, without touching them with the hands. A separate magazine containing twenty blades, shown in the top view, has a beveled extension at one end. This slips into a groove in the back of the razor, where it is held firmly. A sliding injector on top of the magazine pushes the new blade into place.

ASBESTOS UMBRELLA PROTECTS FIREMEN

As a protection against sparks and brands from burning buildings, London firemen are being supplied with asbestos umbrellas. In rigorous tests conducted near Harrow, England, firemen wearing asbestos suits and carrying the new safety device were able to approach within a few feet of the most furious blaze. Except for its asbestos fabric, the new umbrella is identical with the type carried as protection against rain. Its compactness when folded permits it to be carried in large numbers on fire trucks.



Shielding themselves with asbestos umbrellas, firemen in England found they could approach the hottest blaze



Drill box delivers any tool desired

DRILL BOX MAKES CHOICE OF DESIRED TOOL EASY

A TIME-SAVING drill box, introduced in France, permits the user to select almost instantaneously a drill of the size desired. Eighty drills, ranging in size from two to ten millimeters by tenths of a millimeter, are contained in the box. To pick one out, a pointer on top of the box is turned to the size in millimeters. The whole top is then rotated until the number of tenths of a millimeter wanted appears in a window at the rim.



Above, placing food on the traveling belt in the kitchen of the automatic cafeteria. Right, the diner receives the food from the belt by pressing a button



Newly painted fire hydrants are covered with a metal cap bearing the words "wet paint" as a warning to all who may approach

FIRE HYDRANT'S CAP WARNS OF WET PAINT

A CURIOUS cap, recently devised for newly painted fire hydrants, warns passers-by to stay clear, and at the same time protects the fresh paint from falling dust. Shaped like a cone, the cap has a hole in its apex. When the cap is placed on a hydrant, the hole fits down over the key connection. The outer surface bears in white letters the warning legend. "Wet Paint." The cap is constructed of sheet metal.

BIGGEST TELEPHONE LINE

THE world's most powerful telegraph-telephone trunk will soon be started in Russia, connecting Moscow, in European Russia, with Khabarovsk, in easternmost Siberia, cities nearly 6,000 miles apart, along the Siberian Railroad.

SERVICE IS AUTOMATIC IN NEW CAFETERIA

A RESTAURANT recently opened at Prague, in Czecho-Slovakia, offers its patrons the latest development in completely automatic service. On entering the restaurant, a diner pays the sum fixed for a meal, takes a numbered place at a long counter, and presses a button. An endless belt, running down the middle of the counter, brings him the first course. That finished, he presses the button again and receives the second course, and so on through his meal. Other belts, running in a reverse direction under either edge of the counter, are used by attendants to return dishes to the kitchen.

TRAFFIC LIGHT'S CHANGE GAGED BY WHITE LAMPS

BY MEANS of a traffic signal just invented in England, motorists and pedestrians are told how much time remains before the lights will change. The upright panel of the signal contains a green lens at the bottom, six slots, and a red lens. When the green lens is illuminated, the slots are white. One by one they go out. By the number illuminated a motorist knows how soon the light will change and the red stop light appear.



White lights gage time of traffic signal's change

The Man



with the Net

NOURISHING pancakes, tasting like corn fritters, are made from the pollen of cat-tails.

AIRPLANES can fly lower than submarines can dive. Machines landing on the Sea of Galilee, in Palestine, are 680 feet below sea level, far beyond the record depth for underwater boats.

LIPSTICKS sold in London have the color and flavor of wine.



THE LANGUAGE most intelligible over the telephone is Italian; the one conveying the most ideas in the shortest time is French.

A RIVER of ink flows through Algeria in Northern Africa. The chemicals carried by the waters of two joining streams produce black iron tannate, an iron ink. One stream flows out of soil impregnated with iron, the other out of a peat swamp filled with tannin.

THE LONGEST nose of history was seven and a half inches long. It belonged to Thomas Wedders, an eighteenth-century Englishman, who made a living exhibiting it.



A FISH in the East Indies shoots insects with a squirt gun. It can fire a drop of water four feet with deadly accuracy, bringing down insects which it gobbles when they strike the water.

AMONG the Yaruro Indians of Venezuela, a man cannot speak to his mother-in-law. In camp they have to sit facing opposite directions.

THE AVERAGE housewife, in washing dishes, handles 340 tons, or 168 times her weight, of china in a year.



RIVERS that run north and south cut away one bank more rapidly than the other due to the rotation of the earth.

HIRUDIN, a secretion obtained from the mouth glands of the pond leech, is used to prevent the clotting of blood.

THE ENERGY expended by 100,000 people talking during a football game, if transformed into heat, would only be enough to boil one cup of tea.



New Efforts May



Research worker in Russia making electrical measurements of the sun's energy as part of Soviet's program to harness the sunlight

SUNSHINE, our greatest source of potential power, is now largely wasted. It is highly probable, however, that a few years hence science will find a way to harness the mighty energy of the sun's radiation. Solar engines and solar heating apparatus will then make it economically practicable for us to use at least a small portion of our now-wasted sunshine to run our factories, light our streets, cook our food, and warm our houses.

In the United States we use, each year, something like a half billion tons of coal, a half billion barrels of oil, and fifty billion horsepower hours of water power for heat, light, and power. If it were possible to convert all this energy into power—which of course it isn't—it would produce seven trillion horsepower hours. If it were possible to convert completely into power all the solar energy that each year falls on the United States in the form of sunshine, it would amount to seven thousand trillion horsepower hours. Of course, some of the sunshine that comes to us through 93,000,000 miles of space is needed for the general heating of the earth and for the growing of plant life; but above those fundamental needs, solar radiation provides a potential supply of power many thousand times as great as the amount now supplied by other sources.

Solar radiation experts estimate that the sun emits 12,500 horsepower of energy for every square foot of the 585 billion square miles of surface it exposes to the earth. By far the greater part of this almost unthinkable amount of power is lost on its long journey through space, but the radiant energy that reaches the outer surface of the earth's atmosphere is equivalent to 7,300 horsepower per acre, and at noon on a clear day 5,000 horsepower per acre is transmitted through our atmosphere to the land surface of the earth. The theoretical power value of the sunshine that falls on the 133 square miles of the city of Philadelphia is equal to the power that could be generated by a hundred Niagaras. The Sahara Desert, in a single day, receives solar energy equal to the power that would be produced by burning 6,000 million tons of coal.

No one thinks that it ever will be possible to convert into mechanical power anything like all of the theoretical power value of the heat reaching the earth from the sun. Steam boilers and steam engines have been built for a good many years now, but no boiler or engine has been built that can convert all the heat of coal into its theoretical equivalent of actual power. The heat value of good coal equals 12,760 horsepower hours a ton, but the best result ever obtained from a ton of coal with a boiler and steam engine is 1,470 brake horsepower hours, 11.5 per cent of the fuel's heat value.

That the use of solar radiation for power is no vague dream of the far-distant future is shown by the fact that at present a solar power plant with a thermal efficiency of 4.32 per cent—over one third of the efficiency of the best steam engine—has been built and is being operated.

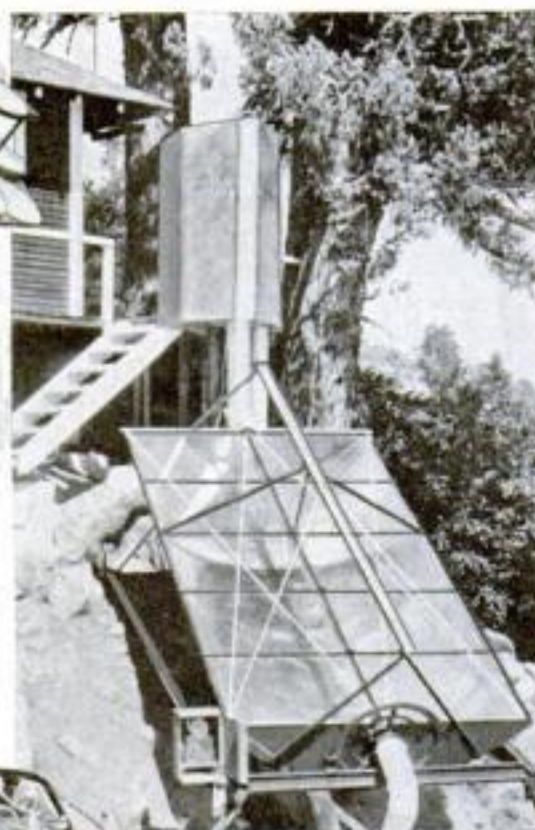
Dr. Charles Greeley Abbot, the secretary of the Smithsonian Institution and the world's leading authority on solar radiation, says that before



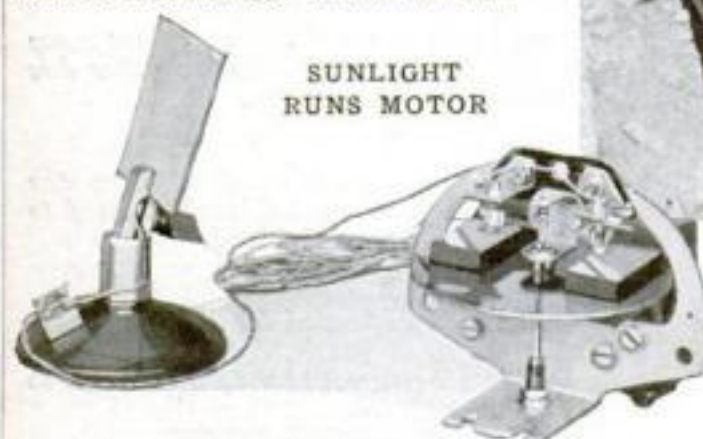
This bank of solar boilers has been installed by the Soviet Government at Tashkent in central Asia where efforts are being made to capture the sun's energy



Model of the fifteen-foot solar furnace recently completed at the California Institute of Technology. Mirrors are used



SOLAR COOKSTOVE
Built by Dr. Abbot on Mt. Wilson, California, this solar cooker uses an aluminum reflector to direct the sunlight upon a pipe containing cylinder oil. The heated oil is then used to warm the ovens. In general enough heat is generated to cook all foods



SUNLIGHT RUNS MOTOR

A combination of metals in the plate at left turns sunlight into electricity. In this way sufficient power is captured to run a small motor. This is a German method for power

Harness SUNLIGHT •

By ROBERT E. MARTIN

long we shall find a commercially practicable method of harnessing sunshine. "Financial success probably awaits the solver of the problems of collecting solar heat for power purposes," he says. "With our present outlook it seems to me likely that within another generation or two power demands will lead to the sun as the most available source of supply."

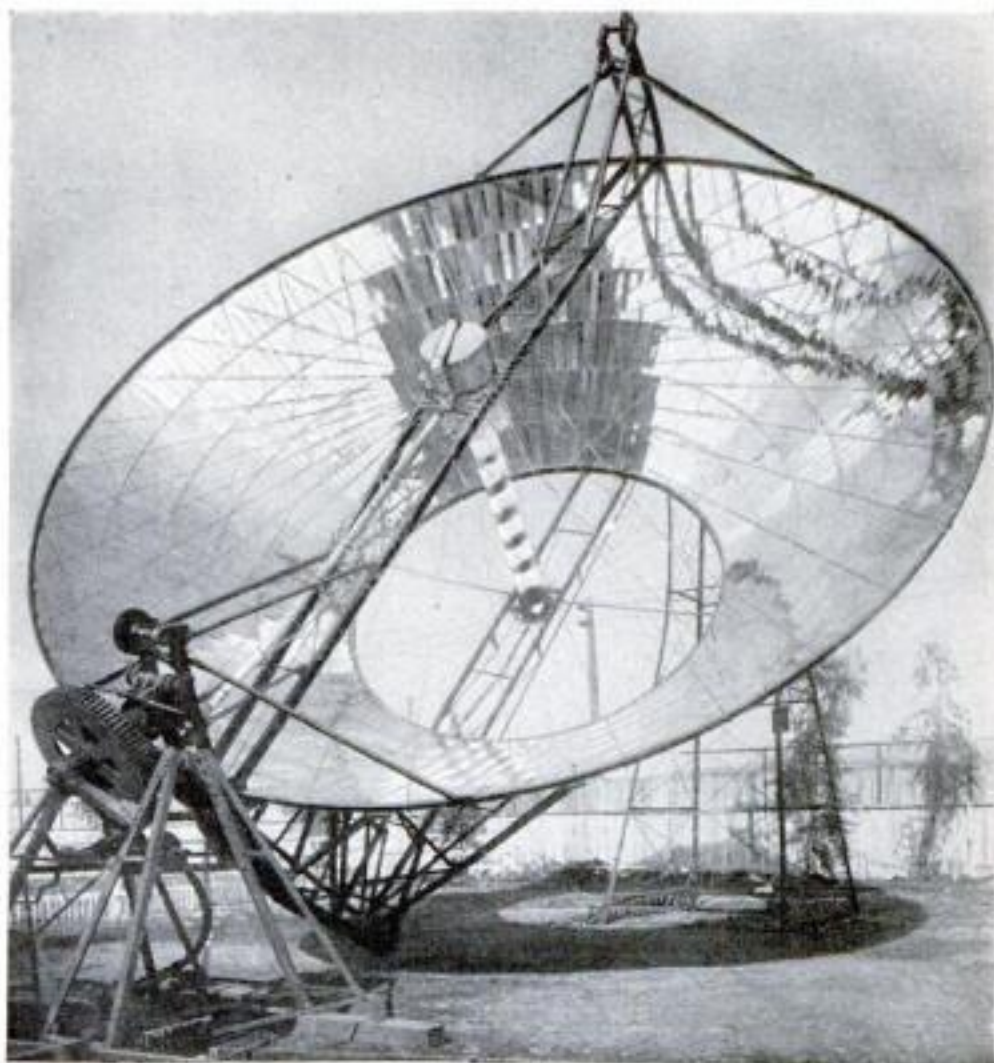
Over 2,000 years ago, a few wise men knew enough about solar radiation to concentrate the sun's rays for their own benefit. Among them were the pagan priests of ancient Rome, who occasionally allowed the sacred fire in the temple of Vesta, the Goddess of the Hearth, to go out, and then rekindled it by placing a piece of carefully dried wood in the focus of a conical metal reflector and letting the sun do the rest. Also there is a classical story that the famed philosopher Archimedes, when a Roman fleet was attacking Syracuse in 214 B.C., set fire to the Roman warships by concentrating sun rays on them by means of mirrors erected on the shore.

It was in an effort to prove the possibility of this tale that, in 1747, Buffon, a French naturalist, made the earliest known scientific experiments leading toward the utilization of solar energy. He mounted over 300 small glass mirrors on a frame so that each of them could be adjusted separately, and so that all of them could be made to concentrate their rays at any desired distance. With this apparatus he set fire to wood over 200 feet away, and melted silver at a tenth of that distance. A few years later Hoesen, a mechanic of Dresden, built a mirror ten feet in diameter whose concentrated rays almost instantly melted coins. To-day, almost two centuries later, scientists still are interested in burning glasses. Dr. George E. Hale, astronomer at the Mount Wilson Observatory in California, recently designed a fifteen-foot instrument with thirty lenses that generates a temperature of 6,000 degrees centigrade that melts steel wire as fast as an ordinary gas burner would melt butter.

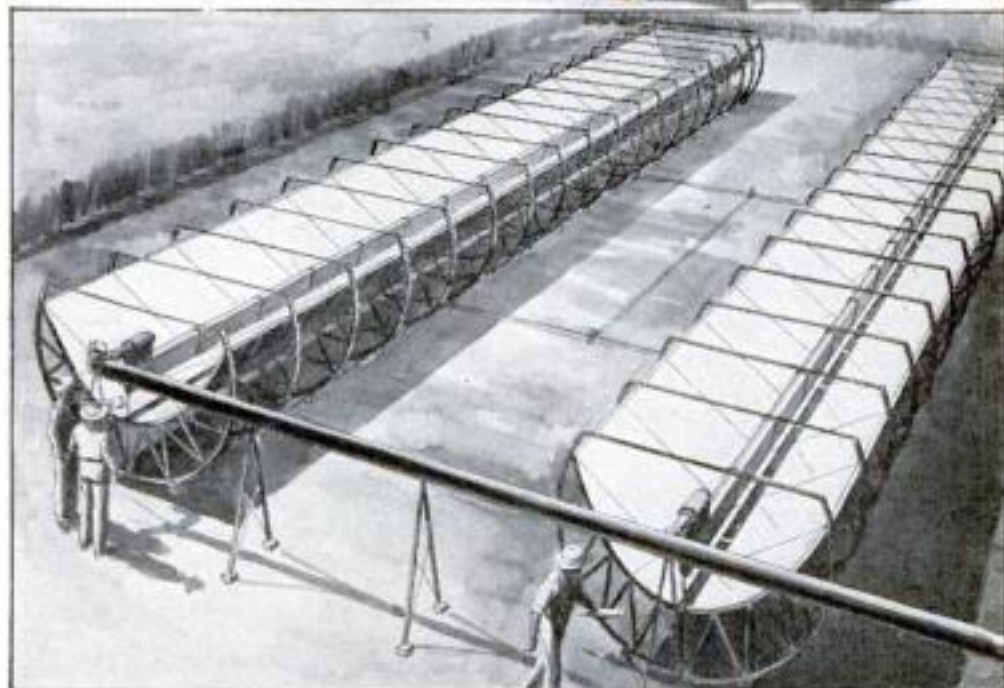
About twenty years after Buffon's experiments, H. B. de Saussure, a Swiss scientist, invented the solar hot box. Realizing that it is not until the sun's radiant energy strikes some material object that it is converted into heat, and that black, which absorbs all of the sun's rays, is the most efficient color for this conversion, he constructed a small wooden box, painted it black inside, and covered it with two sheets of plain glass with an air space between them. Just how high the temperatures were that he obtained in this box when he set it in the sun is not known, but when, in 1837, Sir John Herschel used a similar box in Cape Town, a thermometer in it registered 240 degrees Fahrenheit. Sir John astonished his neighbors by using his apparatus for the homely purpose of frying eggs and stewing meats and vegetables. So it seems that his crude hot box was a sort of rough draft of the solar cooker that in recent years Dr. Abbot has developed to a high degree of efficiency.

De Saussure and Herschel had been content to prove that it was possible to collect the sun's heat. In 1874, August Mouchot, a brilliant French engineer and the greatest of the pioneer harnessers of the sun, took a long and bold stride forward. He used concentrated reflected sun rays to generate steam in a boiler, and used that steam to operate a small engine.

Mouchot's apparatus, the first solar power plant, consisted of two principal parts—a reflector and a boiler. The reflector, a truncated copper cone lined with thin silver leaf, looked like a big lamp shade pointed skyward. It was thirty-two inches deep, had a diameter of forty inches at its base, and a diameter of 102 inches at its mouth. A hand-operated [\(Continued on page 112\)](#)



This strange looking machine is a solar engine erected at Pasadena, Calif. The ring of mirrors concentrates sun's energy and the outfit is reported to have produced about four horsepower



At top, heating water with a solar boiler at the Soviet's experiment station at Tashkent. Above, view of the most successful solar power apparatus thus far made. It was erected near Cairo, Egypt, and uses boilers placed at focus of horizontal reflectors

STAMPS *tell*

How a Collection Album Illustrates
Many Fields of Human Knowledge



NAVIGATION

CAN you describe in detail a common United States postage stamp? If you can, you are exceptional. We may think we know what they look like, but it is difficult to tell offhand, without peeking, just what figures or phrases are used, let alone describe the central picture or border designs. The recent Mother's Day and NRA commemoratives are exceptions, since the criticism and controversy aroused by these miniature steel engravings made us examine them more closely. It is recalled that a vase of flowers was smuggled into the reproduction of Whistler's Mother, and the fact that in the NRA issue business was out of step with labor and agriculture provoked some amusement, but even these two well-known stamps will catch most of us. For instance, is the "three cents" spelled out or indicated by a figure? Moreover, what three-cent stamp issued last year had both "three" and "3" on it?

But the study of stamps can be more than a game. It is instructive. Virtually every science from Archaeology to Zoology can be traced in stamps. A few examples will make this clear.

Take botany, for example. A wealth of familiar and exotic plant specimens may be gathered from among the postage stamps of the world, and these samples may be pressed between the pages of an album much as actual specimens from a field study are preserved. Cuba's palms, China's rice fields, balsams (misnamed balsam Peru) from Salvador; rubber-gathering in the Cameroons, cotton in Egypt, grapes from Liechtenstein (carried on a tray by the famous "grape girl"); the cedars of Lebanon, Ecuador's national pride "cacao" (cocoa to us); and as a final, beautiful instance of the close tie-

up between stamps and botany, the Turk's-head cactus after which the Turks Islands were named (see the Turks and Caicos Islands stamp illustrated on this page).

The student of zoology may arrange his specimens in order from A to Z, from the ant-eater of British Guiana to the zebra of Nyassa, Africa. Moreover, he may classify by species and sub-species. Even varieties of the same animal may be studied; for example the small-eared tractable Indian elephant on the Sirmoor Indian state stamp, and the big-eared, mean-disposed, wild elephant of the Belgian Congo. The single-hump Arabian camel (dromedary) and the double-hump, Bactrian camel of the Orient may be compared in issues of the Egyptian Sudan and Tannou Touva (Northern Mongolia, under Soviet influence).

Liberia, especially, is a happy hunting ground for the zoologically inclined philatelist, with pygmy and normal-size hippos, zebra-striped antelope, red bush-pigs,



ARCHAEOLOGY

which is the largest stamp in the world.

The ichthyologist will ignore the sportive whale of the Falkland Islands stamp, as not a true fish but a mammal, but he will find many real "fish" stamps, including a Newfoundland issue showing a close-up of salmon and entitled "King of the River."

Anthropology, the study of man, and ethnology, covering his geographic distribution, are made absorbing through stamps. Man's habits and habiliments, customs

and costumes can be examined and compared on thousands of stamps. The original Biblical races of Shem, Ham, and Japheth; or the more scientific amplification to the quintet of White, Yellow, Black, Red and Brown races, are authentically pictured. The half dozen shown on the opposite page give an idea of the

possibilities. Starting with the Gabon warrior in feather headdress, self-lacerated features, poison-tipped spears, and cannibalistic appetite, we can run the gamut to the dainty "Mademoiselle from Luxemburg." The Indian prince in his effeminate-looking turban, and next the white-collared, bespectacled President of Liberia. The oblique-eyed little patriot-martyr, Dr. Sun Yat Sen, "Father of the Chinese Republic," and, last but not least, the real American—Salvador's honored Indian Chief Atlatl.

In another group of stamps we have man's conquest of the air, graphically and pictorially traced. Some of these stamps are merely commemorative, others are quite logically issued for air-mail use. Begin with the beautiful Greek air-mail stamp that de-



BOTANY



ZOOLOGY

Story of Science

By
Charles Irving
Corwin



ANTHROPOLOGY

picts a mythical figure of Icarus ascending too near the sun with his wings attached by wax. In the next stamp Brazil honors her citizen, Santos-Dumont, who flew that box-kitelike contraption on November 12, 1906. What progress is recorded in a quarter of a century when one compares that crate of Santos-Dumont's with the modern streamlined monoplane that flies across the face of the Indo-China air-mail issues!

Next is a German invention, the Graf Zeppelin, but on a Russian stamp! The Russian stamp commemorated the flight of the "Graf" from Friedrichshafen to Moscow, and the receipts from the sale of the stamp went into a special fund to build a similar dirigible for the Soviet.

Bringing the progress of aviation up to date, there is the attractive Belgian stamp recording Prof. Auguste Piccard's historic ascent into the stratosphere on August 18, 1932. But new records are being made and broken so rapidly, that fifteen months later the U.S.S.R. Balloon "Stratostat" broke Piccard's record by 9,000 feet. Russia quite naturally did not miss the chance to crow over this achievement, and so brought out a beautiful, graceful series depicting their own aeronautical experiments, with the laconic phrase at the top: "19,000 M." (about thirteen miles to us).

Turning to the field of invention, we find a modern printing press in ancient Mongolia! But that is not strange when we recall that China was the birthplace of printing. Still it is a long step from the crude block printing before the T'ang Dynasty, Seventh Century A.D., to the high-speed rotary press of the twentieth century. Mongolia merely wants the word to know that



INVENTION

she is keeping up with the procession.

Next! The bearded gentleman from Belgium, Zenobe Gramme, is credited with the practical invention of the dynamo. Belgium wants to advertise the fact; hence the portrait of the inventor and



his invention. Incidentally, the specialist who collects only stamps depicting men with beards has a real find in this specimen.

And here is a familiar sight—a steam shovel, and in Russia. The Soviet gives notice that she is prosecuting her five-year plan, with a series of stamps picturing blast furnaces, power sites, and tractors.

From the dynamo it is but a step to a hydroelectric plant on the banks of a river famous in song and folklore. Thus does the Irish Free State advertise a prosaic scene on a romantic stream, the River Shannon. There is another amusing fact: this huge power dam was built by a German contractor and many German



ENGINEERING



STORY OF AVIATION

workers were imported to work shoulder to shoulder with Irish native laborers.

Canada is so proud of her new bridge across the St. Lawrence at Quebec, the longest cantilever bridge in the world, that she pictures it on a 12-cent postage stamp. This bridge has a tragic history for on the first attempt to raise it, it crumpled and dashed eighty-five workmen to death. Now this mighty channel span of 1,800 feet forms a splendid monument to engineering success in spite of temporary failures.

Only two other bridges in North America have been honored on



STAMPS PRINTED ON MAPS



Scarcity of paper often forces postal authorities to make use of odd materials. This block of ten Latvian stamps was printed on the back of an old German war map, as shown in the reproduction of the reverse side. Money was also used

postage stamps—the bridge crossing the Mississippi at St. Louis, and the Niagara Falls Suspension Bridge. There are, however, hundreds of other historic structures on stamps of other countries and there is agitation to have our famous Brooklyn Bridge commemorated postally in the future.

What's wrong with the St. Kitts-Nevis stamp shown on this page? Columbus was a man ahead of his time in more ways than one, but the designer of this stamp took liberties in permitting him to discover America, in 1492, with the aid of a spyglass. The telescope was not invented until more than a hundred years later. This stamp was issued several times with varying designs from 1903 to 1922, but no one took the trouble to convince the postal authorities of their error.

St. Kitts-Nevis is not the only British possession to make a slip on its stamps. The Dominion of Canada issued a map stamp in "Xmas 1898" that showed British possessions indicated over the pertinent phrase: "We hold vaster Empire than has been." This map accidentally but prophetically claims the Transvaal, which was annexed by proclamation September 1, 1900; and the Orange Free State (Boer), which did not acknowledge British sovereignty until May 31, 1902. Moreover, German Southwest Africa was not transferred to Great Britain until after the world war in 1919.

The old New England "Blue Laws" and the strict observance of the Sabbath by the Pilgrim Fathers are recalled by some of the stamps of Belgium. The one illustrated at the right shows the portrait of the late King Albert. What is odd about this stamp is the small detachable portion at the

bottom. If a writer has religious scruples or does not wish to offend some strict observer of the Seventh Day, he leaves the stamp intact, since the perforated tag states *Ne Pas Livrer Dimanche* and *Niet bestellen Op Zondag*—the French and Flemish for "Do not deliver on Sunday."

Some collectors specialize on stamps depicting boats, steam, sail, or hand propelled. The three boat-stamps reproduced at the bottom of the opposite page hail from Russia, Greece, and Costa Rica, and each stamp carries a story. First: When a Greek multi-millionaire died he bequeathed a million and a half dollars for the purchase

of a warship. They bought an Italian vessel, and renamed it the "Averoff," in honor of their dead, public-spirited citizen. Second: the stamp at the left shows the effect of uncontrolled inflation, since it sold for 250,000 rubles, of which 200,000 went for postage and balance of 50,000 rubles to charity. The Slavic inscription

at the bottom reads with bitter brevity—"for the hungry." The third stamp is canceled with five parallel vertical lines, which indicates that the government wanted to make a lot of money at the expense of collectors and so arbitrarily canceled a stock of stamps that had never seen postal use.

We have purposely placed the lady and gentleman in the lower right-hand corner of this page back to back, since the gentleman for years would not recognize the lady; and in fact snubbed her, by refusing to honor her as a stamp on a letter in his country. It's a long story; but briefly the Falkland Islands which lie 250 miles off the Argentine coast, have been a cause of contention among several nations. England and Spain nearly went to war over this 6,500 square miles of rocky land. Argentina once claimed it and had a dispute with the United States. But in the end the Empire upon which the sun never sets, sat on the islands, and the Falklands are today British territory with British subjects—all 2,000 of them.

The Shanghai local city stamp in the center of the opposite page is curious on several counts. It contains words in three languages, English, Chinese, and Latin. With a good reading glass, the flags of a dozen foreign nations can be recognized. Austria, Great Britain, France, Germany, Netherlands, Norway, Portugal, Italy, Russia, Spain, Sweden, and the United States. Moreover, the Union Jack seems to be under the Stars and Stripes. However, England has no cause to object, because Old Glory also seems to be upside down.

The Spanish stamp at the top of



COLUMBUS
THE SEER



BLUE LAWS



STAMPS FOR MONEY

FATHER AND SON



NOT SPEAKING?





TWO HALVES

this page is one of a series commemorating the "Spanish-American Union." However, in this case the stamp is not especially symbolic of union since the two halves appear in the wrong relation to each other. This error occurred when the stamps were perforated incorrectly.

The Serbian stamp to the right of it is one of the "horror" stamps of Europe. When viewed normally it appears to be merely the profile view of the "Trni Gyorgye"—Black George, Serbian patriot, and a subsequent monarch, King Peter. But if the stamp is inverted, as illustrated, the death mask of King Peter's immediate predecessor can be discerned. The story is told that King Alexander and his consort were brutally murdered so that King Peter might ascend the throne, and the martyred king's friends secretly arranged to have his death mask hidden in the stamp design to advertise the assassination.

Which of the Jamaican stamps on this page contains an error? The one to the left has a mistake in its left border. The Union Jack should have a wider stripe of white above on one part of the cross than below. This error was later recognized and corrected, as can be plainly seen in the similar stamp to the right. For a while, however, the Union Jack appeared upside down, a sign of distress.

The two stamps from Roumania in the lower left-hand corner of page 36 contain the portraits of a father and son who both ruled the country. But the son, ex-king Michael (Mihai) was king *before* his father, and if he outlives his dad he will probably be king again. His father, the present king Carol II, temporarily renounced his right to the throne. But the thought of being king finally proved too much of a temptation, so Carol returned to his native country and his son became a little prince again.

In the lower right-hand corner of this page are two unusual stamps: one from Poland, the other from Brazil. The Polish stamp not only honors its two heroes Kosciusko and Pulaski, but also pictures our own George Washington. This stamp was issued as a friendly gesture by Poland coincident with our observance of the Washington bicentennial. The Brazilian stamp shows the late King Albert of Bel-



A KING'S DEATH MASK

gium and the President of Brazil. It was issued to commemorate the visit of the Belgian sovereigns to South America.

At the bottom center of page 36 is an illustration of the two sides of a Russian stamp issued in 1913 as part of the Romanoff Centenary series. This stamp was printed for paper money, but it also could be used for postage. Below it are the front and back of a Latvian stamp. This was printed in 1920, when paper was scarce, so the resourceful Letts used some half-finished money as paper stock. A block of ten Latvian stamps, imperforate, are shown at the top of page 36. These came out in 1918; and old German war maps were pressed into service. The back of this same block is also shown.

There is an American law which prohibits advertising on stamps. But in Italy, the postal administration was permitted to sell advertising space on the bottom of the



MISSED THE COLORS



FIND THE ERROR

regular postage stamps. Above are shown two examples; one a liquor ad, and the other a more familiar emblem of the Singer Sewing Machine, "Maccione Singer Percucire".

New Zealand also experimented with selling advertising on postage stamps, but in a less blatant form, since the advertisements were on the back of the stamp. The stamps shown above were issued in 1878, and the advertisements were written



IT PAYS TO ADVERTISE

either vertically or horizontally as the clients desired. The agency even used some of these stamps to announce the fact that such space could be bought.

In the heyday of stamp advertising in New Zealand, letters were decorated with sales messages extolling such commodities as table jelly, cocoa, coal, dandelion coffee for indigestion, men's and boys' clothing, cough remedies, and Irish moss. In the United States, however, the law against this kind of advertising has been enforced so jealously that even on the commemorative issues brought out in connection with national expositions the Postmaster General has to be careful as to the phrases used in the designs.

This advertising is now discontinued, but many governments publicize their important products and resources both in the designs on stamps and on specially worded cancellations.

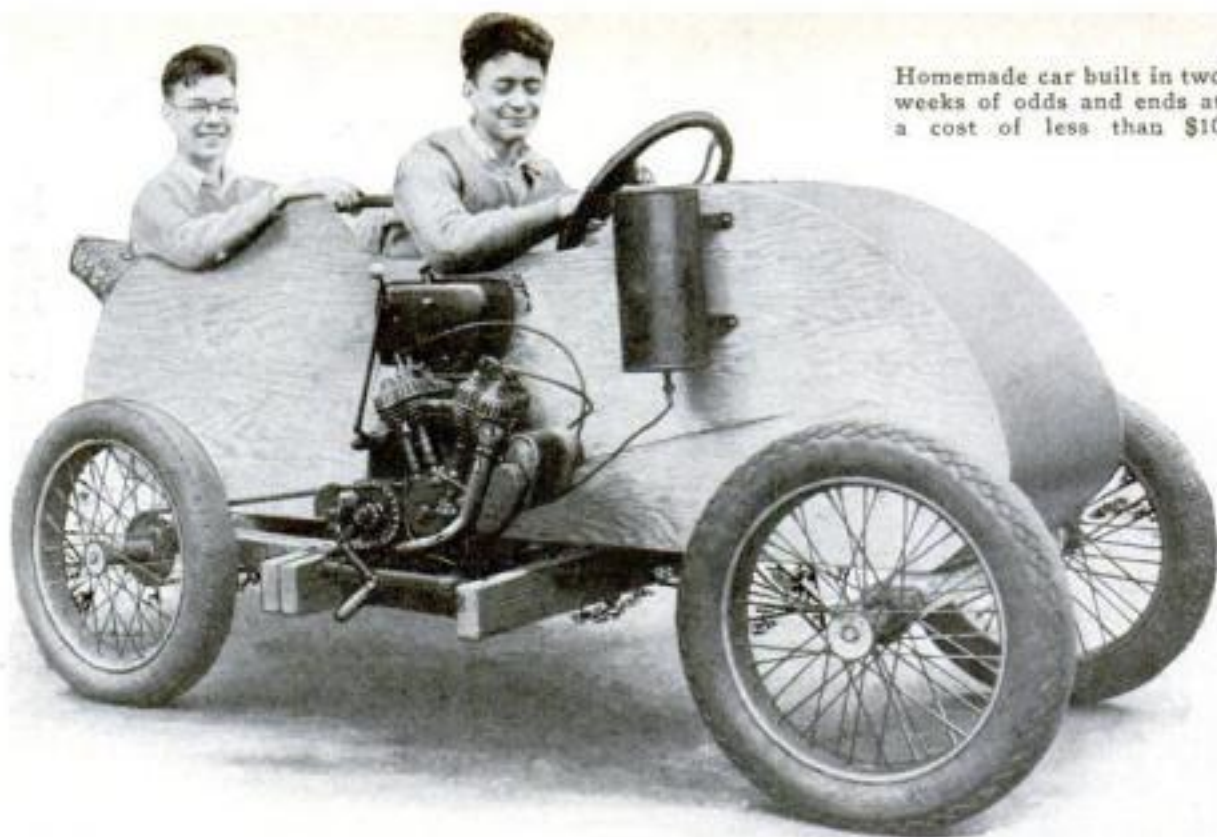
Thus does the stamp collector's album illustrate the many fields of human knowledge and activity. It is a picture-book of science, in which the pictures are all diminutive works of art, produced by skilful designers. To turn through its pages is an adventure in which strange and interesting facts are confronted on every leaf.



GREAT MEN OF HISTORY



JOIN THE NAVY AND SEE THE WORLD



Homemade car built in two weeks of odds and ends at a cost of less than \$10

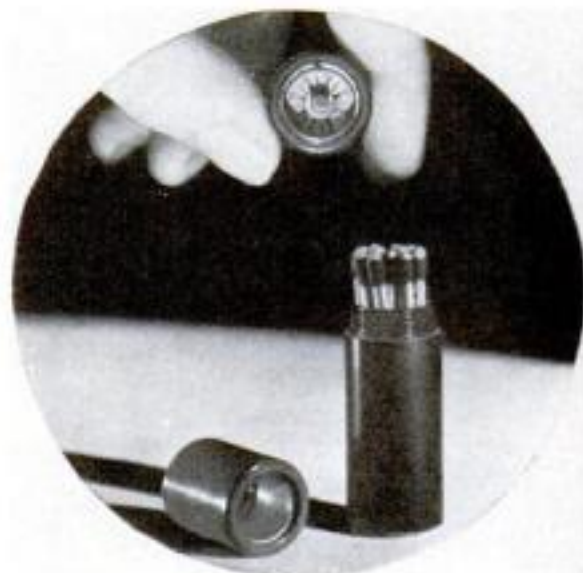
HOMEMADE CAR IS BUILT IN TWO WEEKS

THOUGH it bears little resemblance to the sleek, shiny cars that come off factory production lines, a homemade automobile, just completed by two seventeen-year-old San Francisco boys, will go forty-two miles an hour. All the mechanical parts came from second-hand dealers and the

whole car cost less than ten dollars. The power plant is an old two-cylinder motorcycle engine. A motor-cycle chain is used to transmit the power to one of the rear wheels. The sides of the body are of laminated wood. The car took only two weeks to build.

COMPASS AND BURNING GLASS IN MATCH CASE

A THREE-IN-ONE match case just placed on the market provides the outdoor man with means of lighting a fire even after his supply of matches is exhausted. The bottom of the case is a high-power burning glass that will ignite paper or shavings in short order. Made of light-weight plastic material, the case will remain afloat if accidentally dropped into the water and it is watertight. The top of the cap contains a compass. The case is small enough to be carried in a vest or watch pocket.



LIGHT BULBS LOCKED IN SOCKET BAFFLE THIEVES

STEALING electric light bulbs is made difficult by a recently invented socket that automatically locks the bulb in place. The base of each bulb is fitted with a ring of saw teeth, while the contact seat of the socket contains a short length of flat spring steel that acts as a ratchet. When the bulb is screwed into the socket, the ratchet engages the saw teeth and prevents the bulb from being removed except with a key. The key is inserted in a hole in the side of the socket, and a half turn disengages the ratchet. The bulb can then be readily unscrewed. Ordinary bulbs can be used in the socket but cannot be locked in as the bulb base lacks the saw teeth.

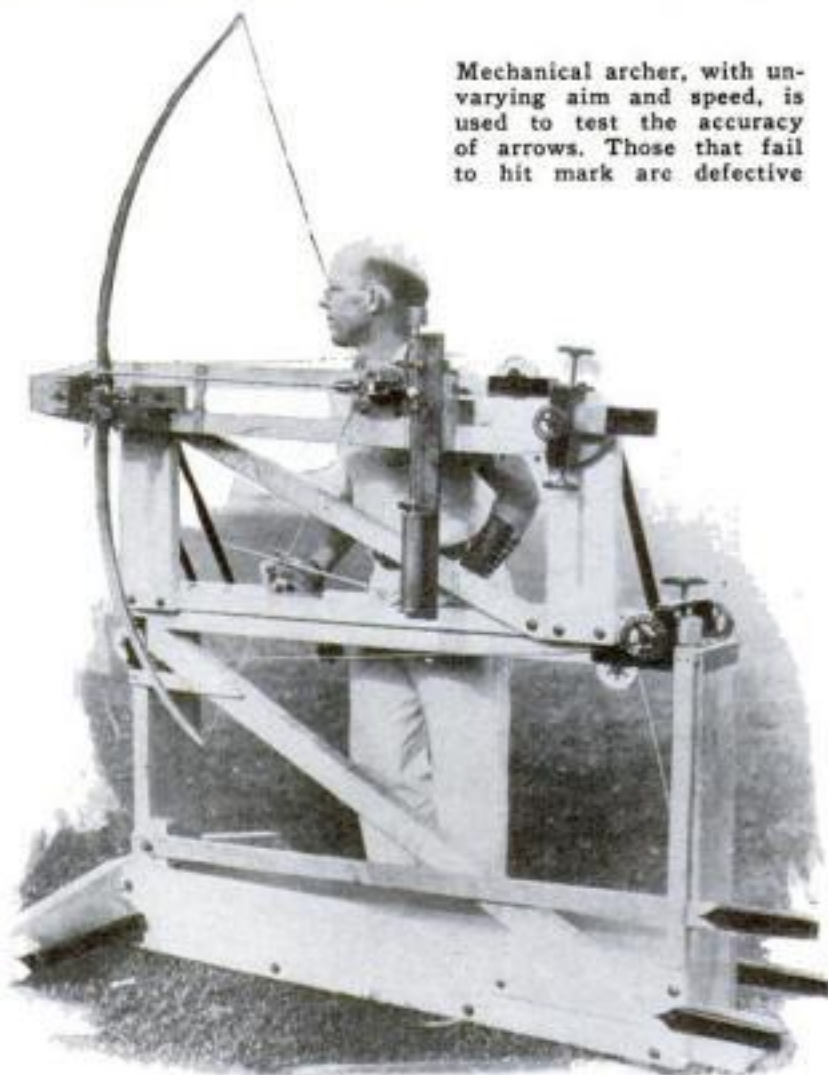
CROW USES BARBED WIRE IN BUILDING ITS NEST

BIRD'S nests with steel framework are the latest curiosity of nature. Recently, telegraph service was interrupted at Clovis, New Mexico. A linesman who went to investigate found a large crow's nest in the arms of a pole. The birds had used pieces of barbed wire and these bits of steel were causing a short-circuit.



MECHANICAL ARCHER TESTS ARROWS

A MECHANICAL archer that does not tire or have the "off" days that plague the human marksmen has been constructed by a Chicago enthusiast to test the trueness of arrows in flight. When a bow is placed in the machine, the string is drawn back by a sliding grip. When the string is released, the arrow is discharged with an aim and at a speed that never vary. This accuracy of aim and uniformity of speed stamp as defective any arrow that does not find the bullseye of the target. The inclination of the arm of the machine supporting the bow, and along which it slides, can be adjusted for various ranges.

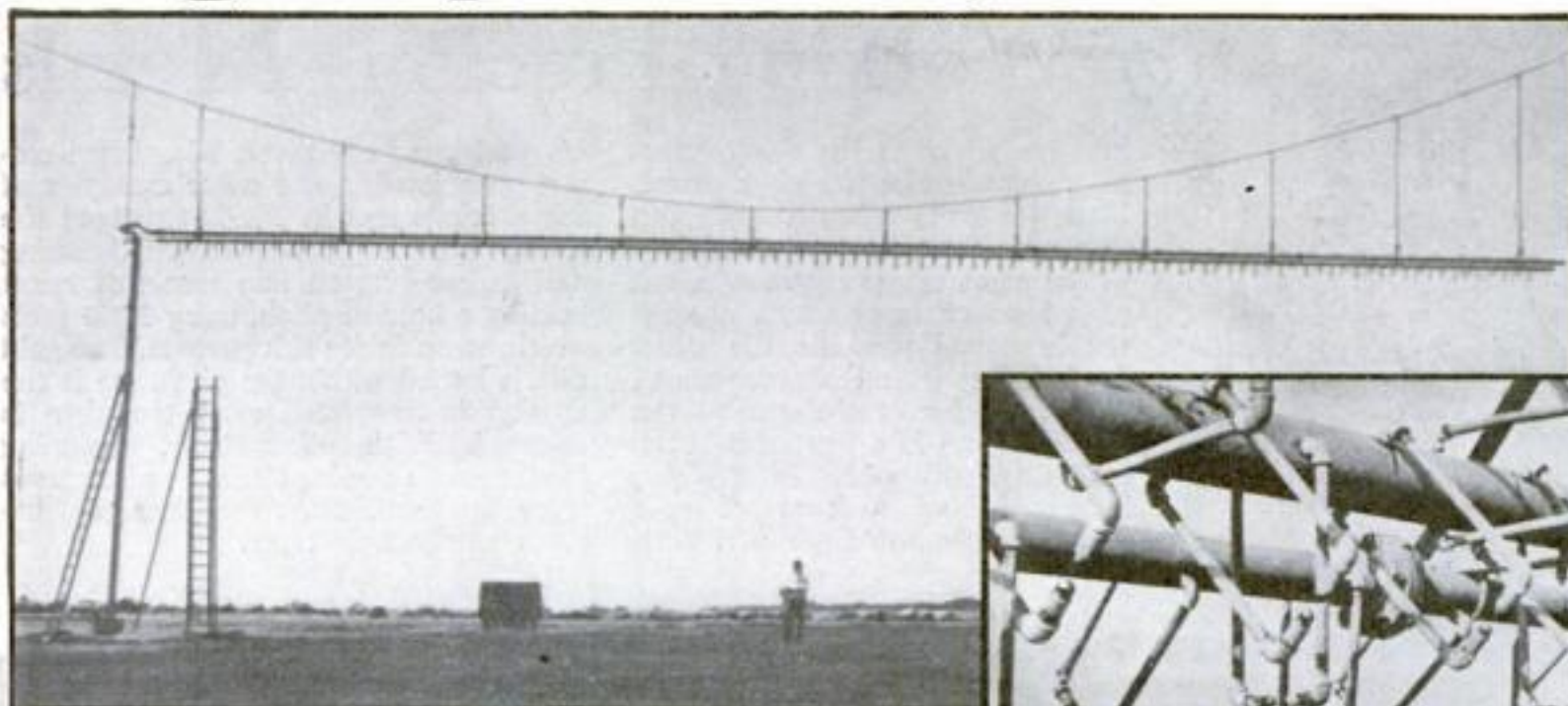


Mechanical archer, with unvarying aim and speed, is used to test the accuracy of arrows. Those that fail to hit mark are defective

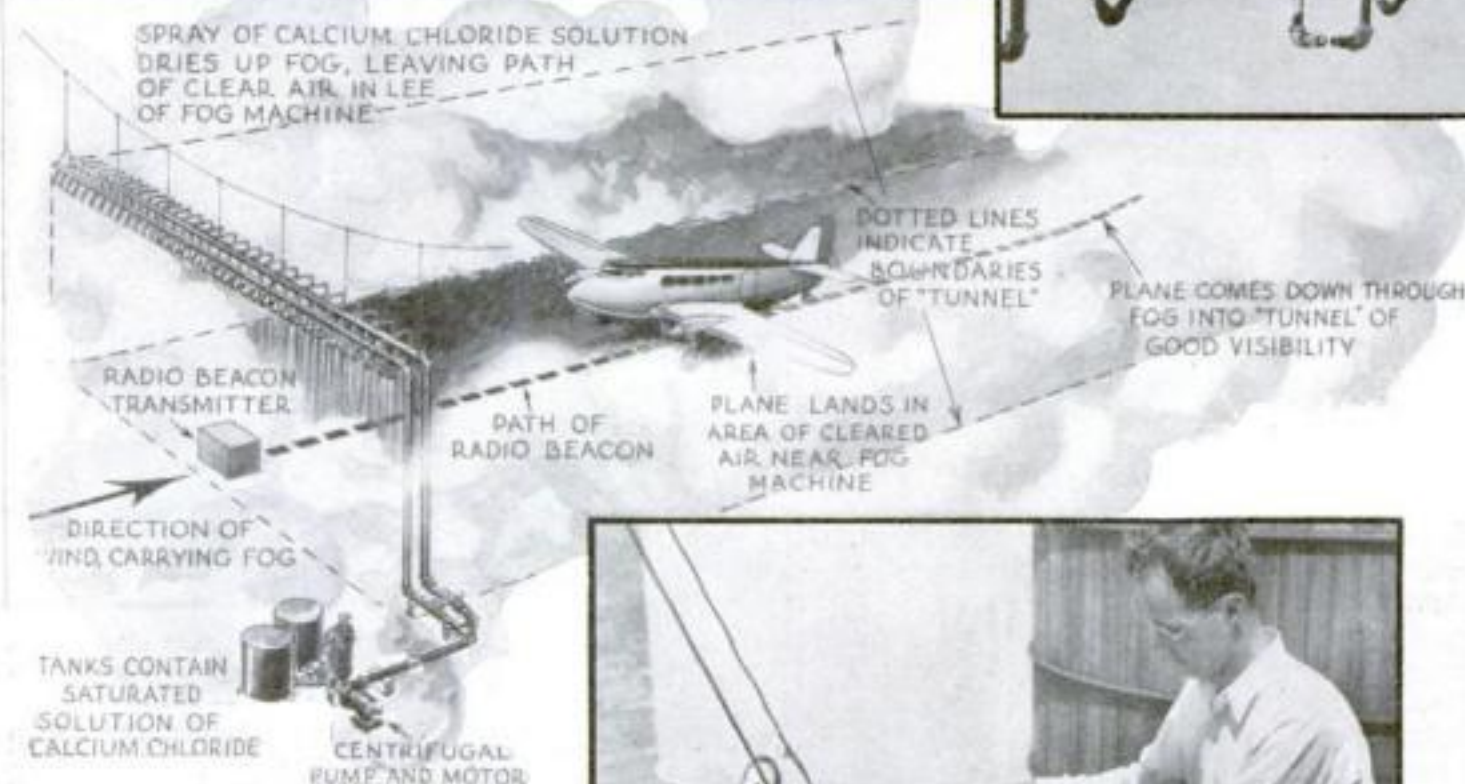
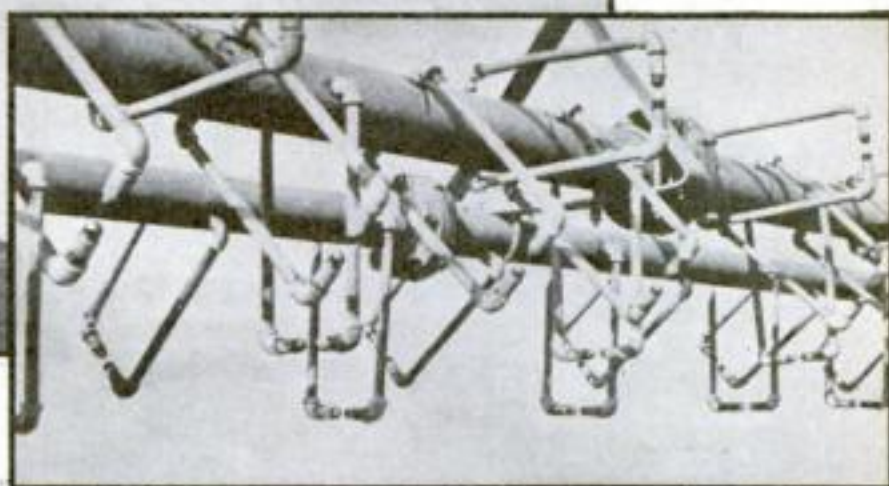
UP-AND-DOWN TOOTHBRUSH

TO MAKE it easier for a person to use an up-and-down stroke in cleaning the teeth, as recommended by dentists, an Oregon man has recently invented a double end toothbrush. Bristles at one end are set at right angles to the handle to form a T. These are used to clean the outer surface with the up-and-down motion. The ends of the bristles form a concave line to conform to the arch of the teeth making up-and-down brushing easy.

Fog Wiped Out by Chemical Spray

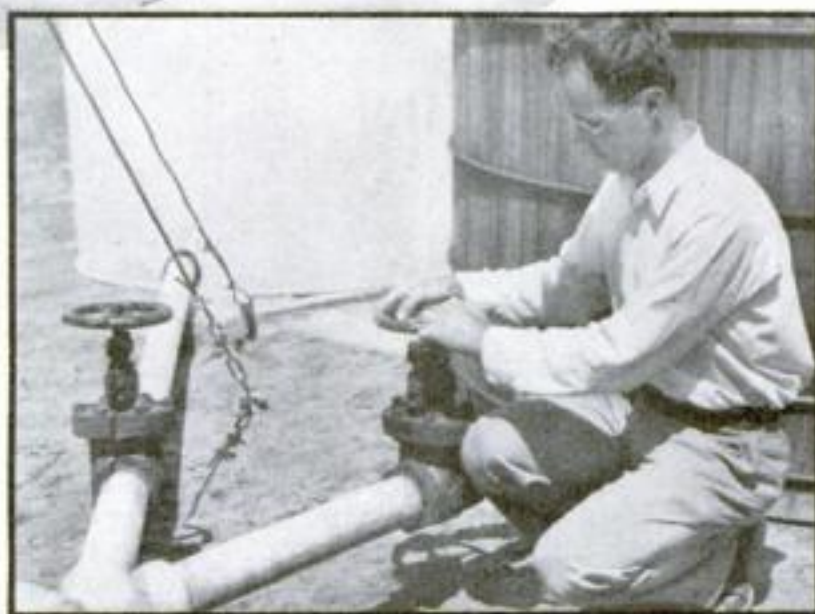


Left, general view of the fog dispeller. The horizontal pipe is 100 feet long and is thirty feet above the ground. Below, a close-up showing nozzles attached to pipe. A pump forces spray out through them



Left, illustration showing how the new fog dispeller could be used by an airport to clear part of the field so an incoming plane could have good visibility for landing. A radio beam would guide plane until it was close to the ground and could glide into the cleared area

THICK, white fog billowed in from the sea and blanketed South Dartmouth, Mass., a few weeks ago. Motorists, forced to slow down, chafed at the delay. But to watchers standing in an open field at the Round Hill research station of the Massachusetts Institute of Technology, it was a long-awaited chance to test an invention promising to end fog's menace to ships and planes. Not far from where they stood, a 100-foot length of piping hung horizontally between a radio mast and a flagpole, thirty feet above the ground. Nozzles branched from it like the legs of a centipede, and a standpipe at one end connected it with storage tanks containing a chemical solution. As the fog enveloped the observers, Henry G. Houghton, Jr., inventor of the strange apparatus, stepped toward the tanks and opened a pair of hand valves. He threw a switch, and an electric pump began to throb. Spray hissed from the nozzles and fell to earth in a hundred-foot curtain. Then a seeming miracle happened. To the leeward side of the spray pipes a clear space opened in the fog, forming a lengthening lane as the



Henry G. Houghton, Jr., designer of the new fog-dispelling apparatus, is shown opening the valve that releases spray to clear away fog

mist drifted slowly past the field. In three minutes, buildings more than a quarter of a mile away were visible along the cleared lane whose bordering walls were still impenetrable to the eye. In effect, a chunk of the fog 2,000 feet long, 100 feet wide, and thirty feet high had been carved out and removed by the chemical jets.

Thus was demonstrated what the inventor believes to be the first practical means of dispersing fog artificially—a feat that often has been attempted, but has never before been carried successfully beyond a laboratory scale. At present the device is admittedly in the experimental stage, but officials of the U. S. Bureau of Air Commerce and other aviation experts are already considering its adaptability

for airport use. When fog blanketed an airport, an incoming plane could be guided by radio beacon to a point directly above the runway, and the fog-clearing machine would then permit the last fifty or 100 feet of the landing to be made with full visibility. The device would be economical in operation, since it could be turned on just before the plane was ready to land and shut off immediately afterward. The possibility of equipping airplanes so they could spray the fog-dispelling solution is also being considered. So new a departure that no name has yet been chosen for it, the fog dispeller is nevertheless the product of years of research by Houghton and his fellow members of the Massachusetts Institute of Technology research staff. Following his pioneer achievement of photographing and measuring the individual size of fog droplets, to reveal the nature of the enemy he must deal with, he created artificial fogs in his laboratory and tested means of dispersing them. The result was the new apparatus, which employs, as a spray, a saturated solution of an inexpensive chemical known as calcium chloride. This chemical, even in solution, has a strong affinity for water and absorbs it from the surrounding air, reducing the relative humidity and destroying the fog. In this way a large fog-wrapped area could be cleared.

Sculptor Revives Lost Art of Working Precious Metals



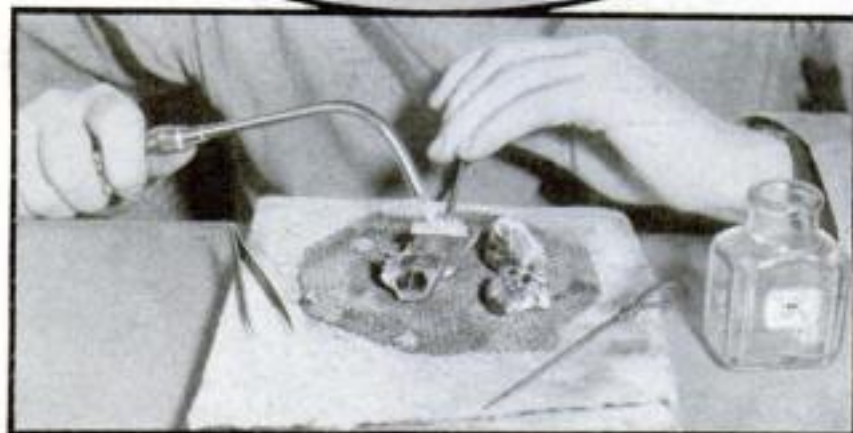
Photo shows modern precious metal worker and some of the 2,000 tools he has designed for use in his new art. Hammered in reverse, the object is then turned over and chased on metal

THREE hours daily for a year Erik Magnussen, Los Angeles, Calif., silversmith, experimented with mercury, gold, and sterling silver. He was seeking the lost art of Benvenuto Cellini, the sixteenth century Italian master, who successfully burned gold into silver and thus created beautiful works of metal art. Magnussen was sure Cellini must have used some quicksilver method, and after a year of trial and error he found the secret. Today he creates silver masterpieces surmounted by gold which he drives

into the silver as the deadly mercury vapors rise under a torch. First, he melts flakes of gold into mercury. Next, he spreads a salve of the amalgam on silver, which is placed on charcoal which absorbs the heat and prevents the silver from fusing with the other metal, touches a hot gas flame to the amalgam, and in a few seconds the quicksilver disappears in a cloud, leaving behind a layer of gold driven deeply into the silver. With

his gold-encrusted silver, Magnussen creates rare jewelry and other examples of the precious metals. He has revived the nearly extinct practice of hand-chasing designs, working on thin sheets of metal held by a base of pitch, using 2,000 tools which he made for this purpose. The gold side is buried within the pitch. On it the chasing is completed after the plate is reversed. With other tools, including crooked-neck carving steels, he also carves ivory by hand. This, too, has now become nearly a lost art.

Below, beetle of black onyx set in sterling silver and embellished with fire gold. Photo shows gold being smoothed with a burnisher



Above, Magnussen is shown with head carved by him from ivory.

Left, mercury into which gold has been melted is placed on a slab of sterling silver. By heating the mercury, gold is driven into silver

ARTIFICIAL DROUGHT TESTS WHEAT

Hot, withering winds and killing droughts are created at will by U. S. Department of Agriculture plant breeders in their efforts to select varieties of wheat that thrive best when deprived of normal moisture. In a recent experiment at the Arlington, Va., test farms, eight varieties were

potted and placed on a motor-driven turntable. The turntable was then rotated before a blast of hot air and each planting of wheat given the same limited quantity of water. This artificial drought showed clearly that some strains of wheat are more capable than others of standing drought.

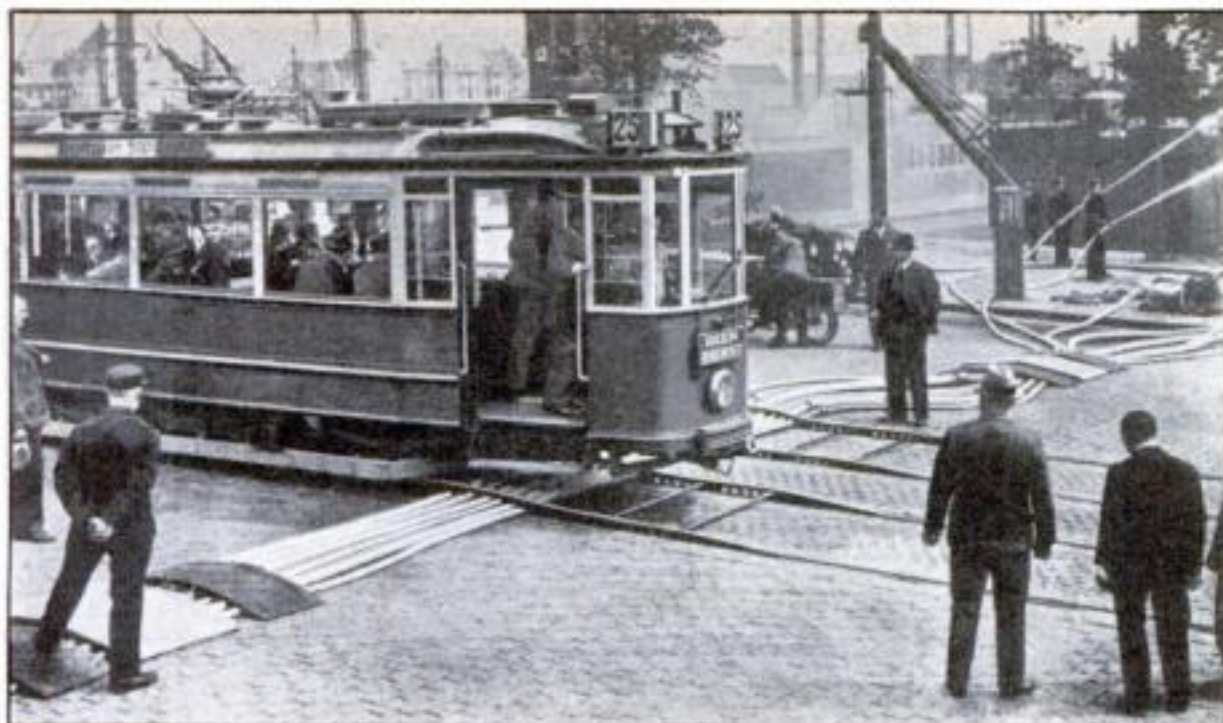


Wheat plants are tested, as shown above, by being placed on a turntable and exposed to hot wind



GAGE ROLLS ON MAP TO GIVE TOURIST MILEAGE

TOURING distances may be instantly calculated from maps with a recently invented counter. The instrument is rolled along the route and the distance is indicated in miles by figures on a revolving disk. The disk is actuated through a gear by a small traction wheel that is held in contact with the map surface. As the instrument is no larger than a pocket reading glass, it may be used conveniently while on a motor trip. For maps of different scales, there are various sized wheels.



BRIDGES LET CARS CROSS FIRE HOSE

TRAFFIC blocks in the vicinity of fires are prevented by ingenious new bridges that carry street cars and other vehicles safely over the hose lines being used by firemen. When recently tested by the fire department at Amsterdam, Holland, the bridges enabled traffic to proceed at a normal pace along a street crossed by eight lines of hose. The bridge used to carry automobiles and horse-drawn vehicles consists of three low steel arches. The hose lines pass between the supports of the arches. For street cars, a short section of supplementary rails with tooth-like bottom edges and sloping ends is used. When the section is laid upon the permanent rails, the teeth in the under side fit between the hose lines.

STETHOSCOPE FINDS GAS LEAKS

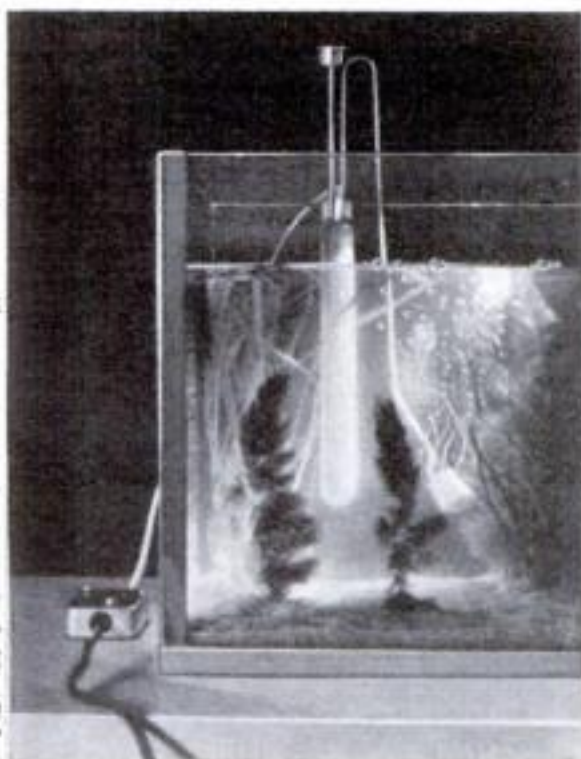
HAPHAZARD excavations to find leaks in gas mains are made unnecessary by the recent invention of a testing device that resembles a physician's stethoscope. It consists of a pipe connection, a cylinder containing a diaphragm, and two rubber tubes for insertion in the ears. Connected to a gas pipe the instrument picks up the vibrations caused by escaping gas, the loudness giving position of leak.



Stethoscope, shown at left and in use above, is used to detect gas leak and find its source

PISTOL GRIP ON BOTTLE CAPPER

DESIGNED to attain high speed in sealing milk bottles in farm and home dairies, a new hand capper is provided with a pistol grip. A tubular magazine for the bottle caps is fitted to the side of the plunger cylinder. When the pistol grip is pushed down, the plunger pushes a cap firmly onto the bottle top. A slot in the grip enables the operator to control the position of the capper with ease while he is using it.



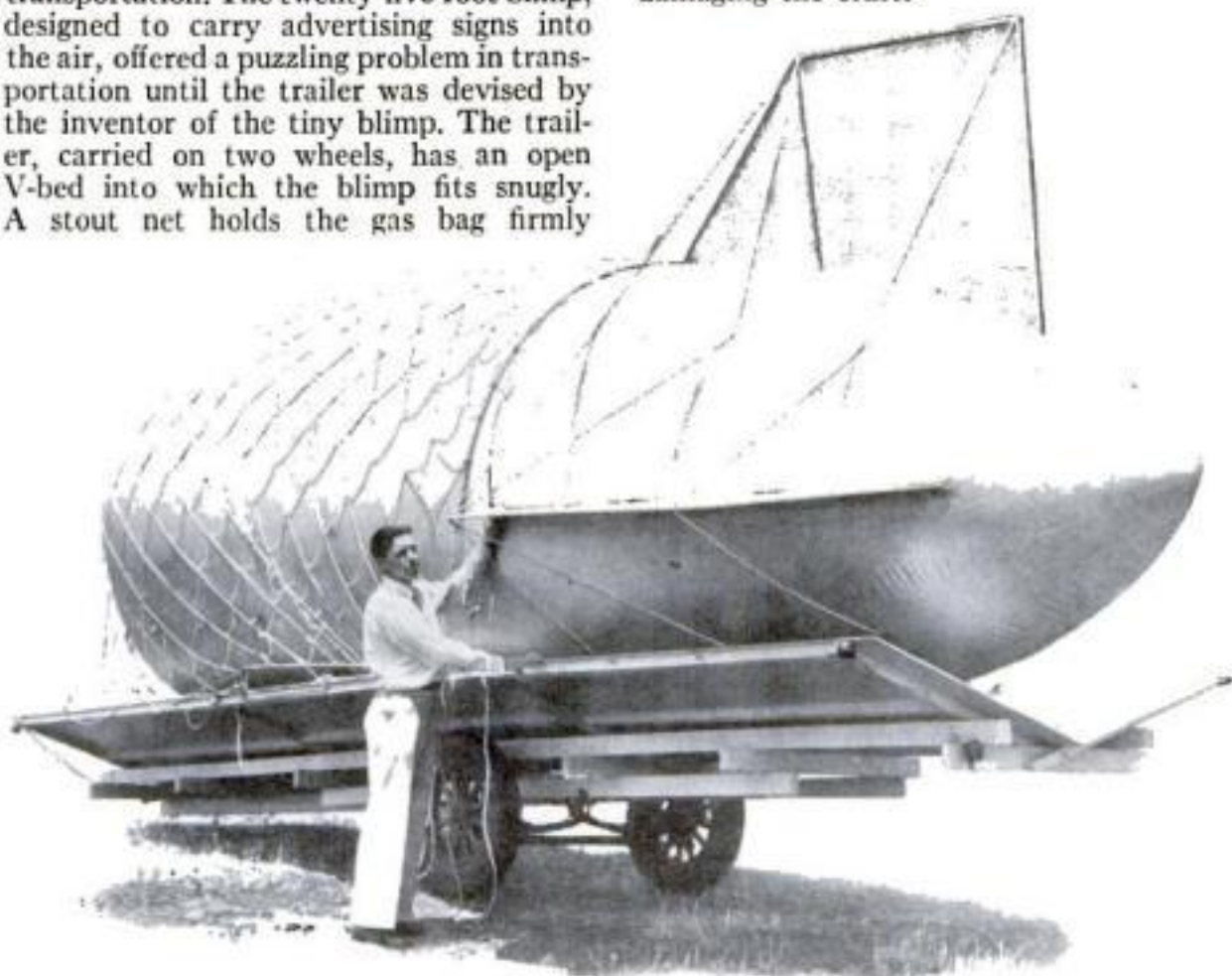
NEW OUTFIT HEATS AIR AND WATER FOR GOLDFISH

A NEW electrical water conditioner for home aquariums furnishes a constant supply of fresh, washed air and keeps the water at the correct temperature. Drawing air from above the tank, the device heats it, washes it, and pumps it into the aquarium. If it is desired to aerate the water without heating it, the tube can be placed in a jar of water beside the tank. Automatic heat control can be obtained with a thermostat.

BABY BLIMP IS TOWED ON AUTO TRAILER

A BABY blimp recently built by a Los Angeles, Calif., man is towed from place to place without deflating by a curious automobile trailer made especially for its transportation. The twenty-five foot blimp, designed to carry advertising signs into the air, offered a puzzling problem in transportation until the trailer was devised by the inventor of the tiny blimp. The trailer, carried on two wheels, has an open V-bed into which the blimp fits snugly. A stout net holds the gas bag firmly

against the wind when it is being hauled along the highway. By means of the trailer it is possible to move the blimp overland at high speed without danger of damaging the craft.



Things I Learned *from* TEN THOUSAND CATS



To brush a cat, put it on a table and grasp it firmly by the body and neck. Then brush with long even strokes the way the fur lies

ONLY by dealing patiently and kindly with a cat, particularly during its early life, may you develop the sort of animal everyone wants as a companion and pet.

Unlike dogs, cats will respond only to kindness. Punish them and they grow surly and spiteful. I speak from rich experience, having bred fully 10,000 cats during the last quarter of a century.

The old idea was that every animal should be punished when caught in a wrongful act, but cats do not understand the meaning of a whipping. They are weak-willed and easily tempted and must, therefore, be guided in paths of righteousness.

Once a mistake is made, a kitten is likely to continue repeating the error until death overtakes him. On the other hand, if you detect the offense early enough you not only can correct it, but guide him into developing lovely traits and teach him one or two tricks that delight the children and visitors.

To get him to jump over your hand or through a ring, for instance, first actually lift him over or through. Put him through the routine half a dozen times the first day and twelve times daily thereafter. After a week, try coaxing him through by holding a morsel of his favorite food on the far side. He may yet require help a few times, but after a while he will get the idea. Later he will jump without thought of reward, but this point is important: never promise a cat anything you do not intend to give him. Cats are unforgiving.

In teaching him to sit up, force him gently back on his haunches in a corner of the room. Do this for only a few seconds, several times daily if possible. Lit-

tle by little, keep him longer in the corner until at last he will sit there alone for half a minute. Then move him away from the corner, bracing him with your hands, gradually withdrawing them as you repeat the instructions, "Sit up." Whenever he is successful, give him a bit of meat.

By constant coaxing, some cats will learn to play dead. First, lay the animal on a rug, on his back, and stroke his body until he falls asleep. After a few days of this, say the words, "Dead cat," as you repeat the process. After a dozen tries, he should play dead on command.

Since some cats are inclined to timidity, get your pet while young, coax him to be friendly, and when other people are around permit him to spend some time in

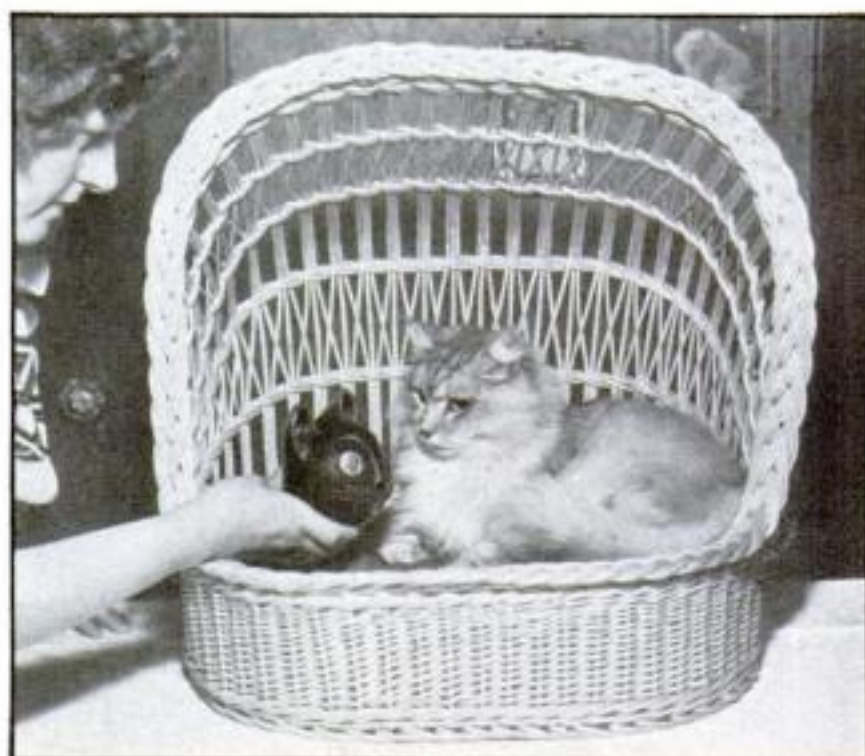
the room. This contact will tend to overcome timidity, as well as any tendencies that might otherwise develop toward spitting and striking. Once any of these habits gets set, it is virtually impossible to change it.

Cats sometimes become spiteful and hold grudges. This is an additional reason for taking kittens only, especially where you have other pets in the house. I have known cats to permit birds to fly onto their back and ride around the room. By starting early, introducing the pets to each other, talking to them with a kindly voice, you can achieve a calm among your dumb pets that rivals that of a happy human family. If you study your cat, you soon will come to understand his reactions and learn to respect his wishes.

Cats may be bathed, but not more often than three times yearly, for bathing takes a large quantity of the natural oil from the coat. Use soapsuds. Never subject them to carbolic, tar, or other strong solutions. These things can kill a cat by being absorbed. I have known a cat's pores to close, ending in death with-

By
A. J.
ADAMSON

Cats appreciate a basket having a high back and top into which they can retreat. In cold weather a cushion and blanket are needed for extra warmth



in five hours, after such unwise treatment.

Always wash the head before placing the cat in a tub. This will drive any fleas down on his body. When finished with the head, plunge the cat quickly into the water. If he will not permit this type of bathing, you can only sponge him to the best of your ability. After removing him from the bath, roll him in a blanket, but do not rub. In cool weather finish the drying with a second blanket, then keep him in a warm room until he is thoroughly dry. In warm weather, you may turn him out in the sunshine.

Before he is thoroughly dry, comb him with a coarse comb. This will make the hair stand out. Finally, wipe his eyes and dust a little dry boric acid into his ears. This helps avoid ear canker. Combing and brushing alone do not produce a good coat. This comes from a combination of causes, including good food, cleanliness of both the cat and the premises, and freedom from fleas. Brushing and combing daily will provide the finishing touches on an otherwise sound coat. Whether you use a soft- or stiff-bristle brush is of little consequence. Many people prefer combs.

No two cats can be held alike for combing. Some will sit and submit peacefully while others stand, back arched, as though in protest. I find it easier to place the cat on a table and brush him while standing. In this way I can control him.

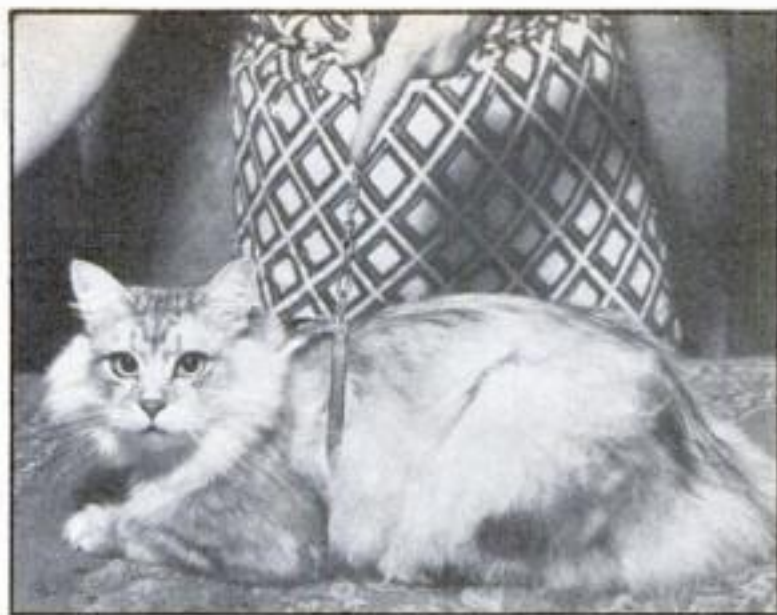
For a heavy coat, a soft brush is best. During shedding time a combination comb and brush proves effective. The comb takes out the loose hair while the brush follows along to smooth down the coat. In fact, it is always better to comb first if the cat is in full coat, following with the brush. Some people do not like brushes, and their attitude is rather supported by the fact that combs alone will produce a shinier coat. After each brushing, take a fine comb through for dirt and fleas.

I have found it good policy to deposit the hair collecting on combs and

brushes in kerosene. This will destroy fleas. This method is usually adequate to meet the menace of fleas, excepting during a time of epidemic. Then a good powder should be rubbed daily into the coat. Good powders will not injure a one-day-old kitten, though care should be taken to keep them away from the nostrils. Place the powder back of the ears and over the entire body, especially under the front legs and on the stomach. In combing, either when dressing or defleaing, start on the head. With long and firm but gentle strokes comb the back and body. Then grasp the cat by the back of the neck to comb the stomach.

Males and females should be accorded the same kind of treatment, including food, except during breeding season, when the male should be fed more meat than he ordinarily would receive. At other times cats should be fed twice a day. Some people think a single feeding is sufficient, but I have found cats to be greedy. In many cases the one-meal-a-day schedule results in indiges-

To keep kittens from drowning when learning to drink milk, place their saucer in the big bowl they will use later on



A loose-fitting harness, such as this, serves better than a collar for a cat as it can escape any other kind of fitting



Many cats prefer a long, soft-bristled brush. Usually a mother will submit easily if kittens are present



To trim the nails, hold the cat faced away from you, grasp paw firmly, and use the pincers

THE old idea was that all animals should be punished when caught in a wrongful act, but cats do not understand the meaning of a whipping. They are weak-willed and easily tempted and must be guided in right ways

tion due to their over-eating. Some cats cannot take milk or raw eggs. If you find your animal does not thrive on either of these foods, do not force it on him, for biliousness usually results. Barley water mixed with canned milk in equal parts proves a good substitute, or in extreme cases barley water alone. I always prefer canned to fresh milk. I have found too, that some cats thrive on buttermilk.

Raw carrots, raw spinach and lettuce provide enough roughage and answer the need for green grass, which is denied many city-bred pets. During mating time, the male requires some milk and egg, while many of the prepared foods are good, especially the vitamin-containing meats and fish. It is best, if possible, to give them some grass. It is an excellent tonic. In cities this may be provided, even in apartments, by planting rape bird seed in dirt, contained in a box. Grass from these seed grows rapidly.

Particular attention should be paid to the diet during the breeding season. After breeding, permit *(Continued on page 116)*

Actors' Rubber Masks to Replace Make-Up



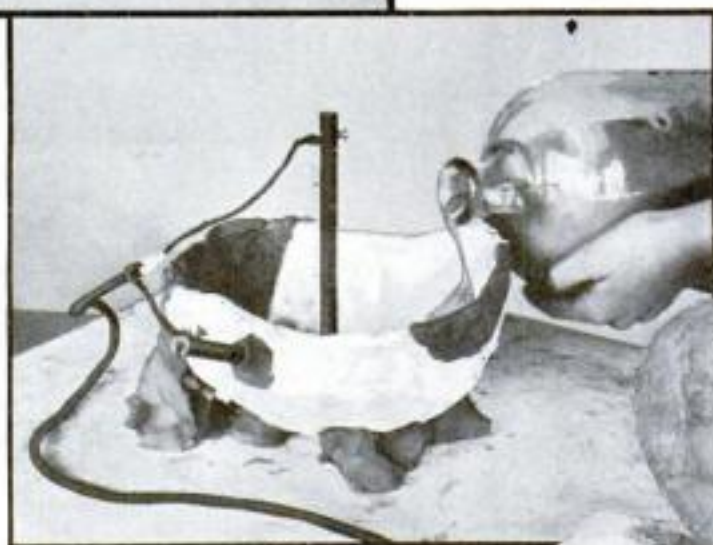
Left, rubber mask covering the entire head. In this case, the eyelashes are attached as the mask was for a mechanical man. Right, the pliability of the rubber mask is demonstrated by stretching. This is the mask shown at left



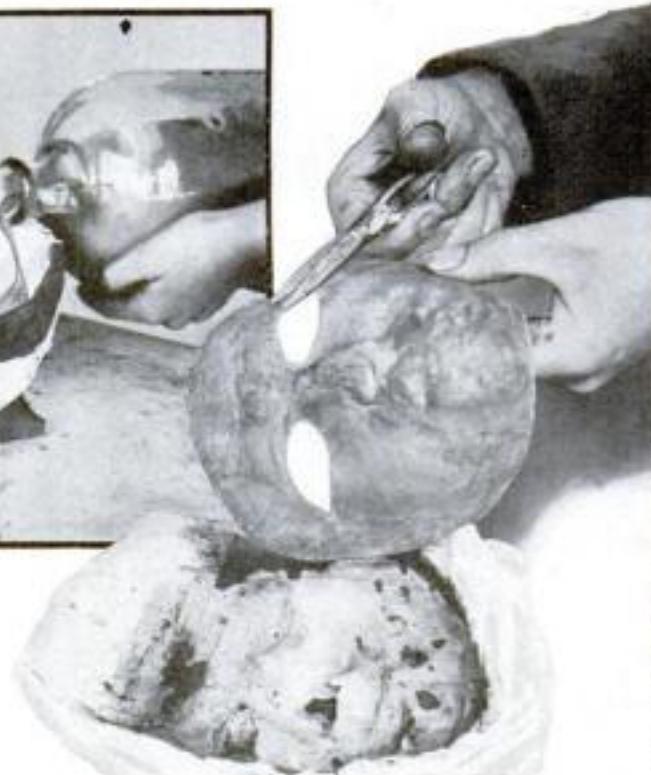
Here Garrett Becker, developer of the rubber mask, is seen working on an old-type mask. Much of this work is unnecessary on the masks he is now making of rubber

ACTORS may now change faces as easily as they change costumes. And they may make these facial changes without going near the make-up box. The secret is the startlingly lifelike rubber masks just developed by Garrett Becker, a New York photographer, painter, and mask-maker. The new masks fit perfectly as they are made from the actor's own features. The face is coated heavily with petroleum jelly and a plaster of Paris mold made. The hardened mold is used to make a cast or skull form. Any desired changes or additions are modeled upon this skull form and from it a second mold is made. This mold is filled with a chemical solution of liquid latex, or raw rubber, and electrodes attached. An electric current passing through the electrodes sets up electrolytic action and a film of rubber is deposited on the mold. This film, after forty-eight hours, is peeled from the mold. Rough edges are trimmed and holes for the eyes and nostrils are cut out and the lips slit apart. The mask is then pickled in a chemical bath to make it pliable. It is then colored with a secret chemical solution that fuses with the rubber and cannot be scraped off.

As the first step in making the mask of rubber, the performer's face is coated with petroleum jelly and then covered with plaster of Paris to make a mold. After this is shaped to suit, a second mold is made which is used to make the mask



To the second mold, electrodes are attached, as shown above. Then into the mold is poured a small amount of liquid latex. Through this an electric current is passed. Electrolysis is thus used to deposit a rubber film inside the mold



Left, the film of rubber removed from the mold. In it holes are cut for the eyes and nostrils and slit for the lips. This is done before the mask is given a lifelike color. Above, mask being adjusted on the face of actor. Portions of neck and head are touched up

Air Propeller Runs Amphibian Craft

This new auto-boat is expected to go fifty miles an hour in water and seventy miles an hour on land



DRIVEN by an airplane propeller and steered by an airplane rudder, an amphibian boat just launched by its builder at Bridgeport, Conn., is expected to skim over the water at fifty miles an hour and to make seventy miles an hour on land.

The craft is thirty feet long and has an inverted V bottom. For highway travel, the boat has three rubber-tired wheels, two amidship and one at the stern. These are attached to the hull by means of pivoting arms, which permit the wheels to be raised

above the surface of the water when the craft is afloat. The five-cylinder radial engine is mounted behind the rear seat and the rudder trails a fixed fin that overhangs the stern. There are seats for four persons in the craft, including the driver.

NEW WIND GAGE SETS AN ACCURACY RECORD

SEEKING a wind-measuring instrument delicate enough to record the lightest breeze yet sturdy enough to withstand a hurricane, Dr. Charles F. Marvin, retired head of the U. S. Weather Bureau, has developed an anemometer said to register wind velocity with great accuracy. The cups of the new instrument are conical and the edges of the cups are turned back to form a bead around the rim. As the rounded bead permits the cups to swirl in the wind with small friction, the rotation of the cups more nearly equals the actual velocity of the wind than is possible with gages now in use. It is unnecessary, therefore, to make the complicated mathematical corrections demanded by other instruments used to measure wind.

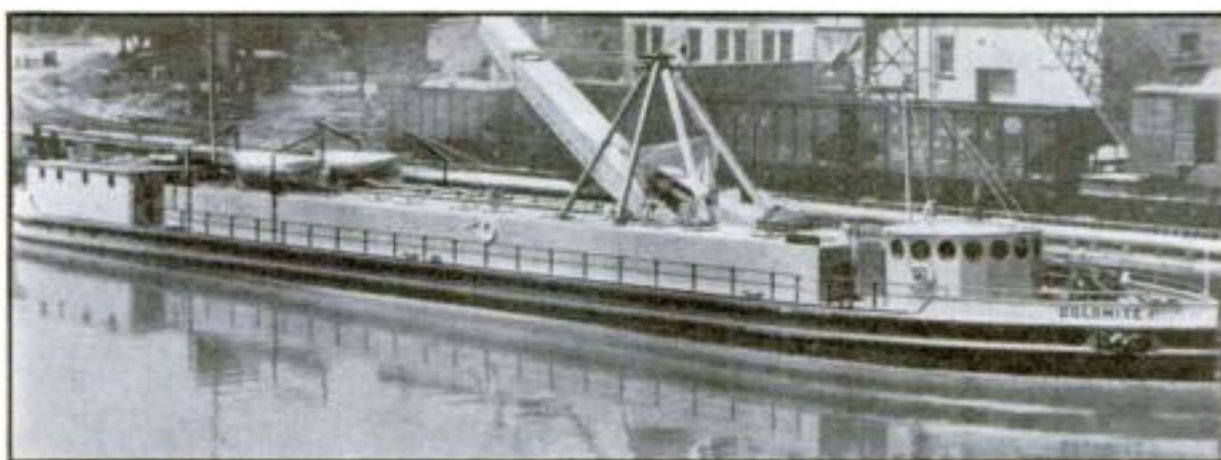


New wind gage with conical shaped cups

BOAT LOWERS ITSELF TO PASS BRIDGES

So IT can pass under the low bridges of barge canals with safety, a queer, squat boat, recently built, employs a submarine principle to make it partially submersible. The craft can increase its draft as a submarine does until its decks are only a few inches above the water. The new boat is

built of steel channels welded together and is powered by a Diesel engine. It can carry 1,700 tons of either dry or liquid cargo, being convertible into a tank within three hours. The boat is intended to carry cargo from the Gulf of Mexico to Great Lakes ports.



Adopting a principle from the submarine, this new canal boat can partly submerge itself so it can pass beneath low bridges. It can be converted into a tank for liquid cargo in three hours



Built largely of aluminum, to lessen its weight, this drawbridge, recently put in use, is so light it can be operated easily by one man

ALUMINUM DRAWBRIDGE WORKED BY ONE MAN

BUILT of aluminum to save weight, a drawbridge just placed in operation in an Arnold, Pa., mill is easily raised and lowered by one man. The bridge, which is fourteen feet long and just wide enough for one person, spans a railroad siding between two units of the plant. Anchored in a concrete platform, the bridge is operated by means of a converted hand winch, and can be raised or lowered in a few seconds. For safety, it can be locked either in the raised or lowered position. The short sub-frame of the bridge is steel, as are the counter-weights and that portion of the decking behind the pivot point, but the remainder of the structure is aluminum. The bridge, it is estimated, will support a moving load of 500 pounds. A pit in the platform accommodates the counter-weights.

BIGGEST FIREFLY IS USED AS LANTERN



Left, firefly in flight has red light at its tail. At right, beetle photographed by its light



Left, view of Central American jungle lighted by the big fireflies. The white streaks are made by beetles while they are in flight. These are examples of unusual photos made in the jungles of Central America



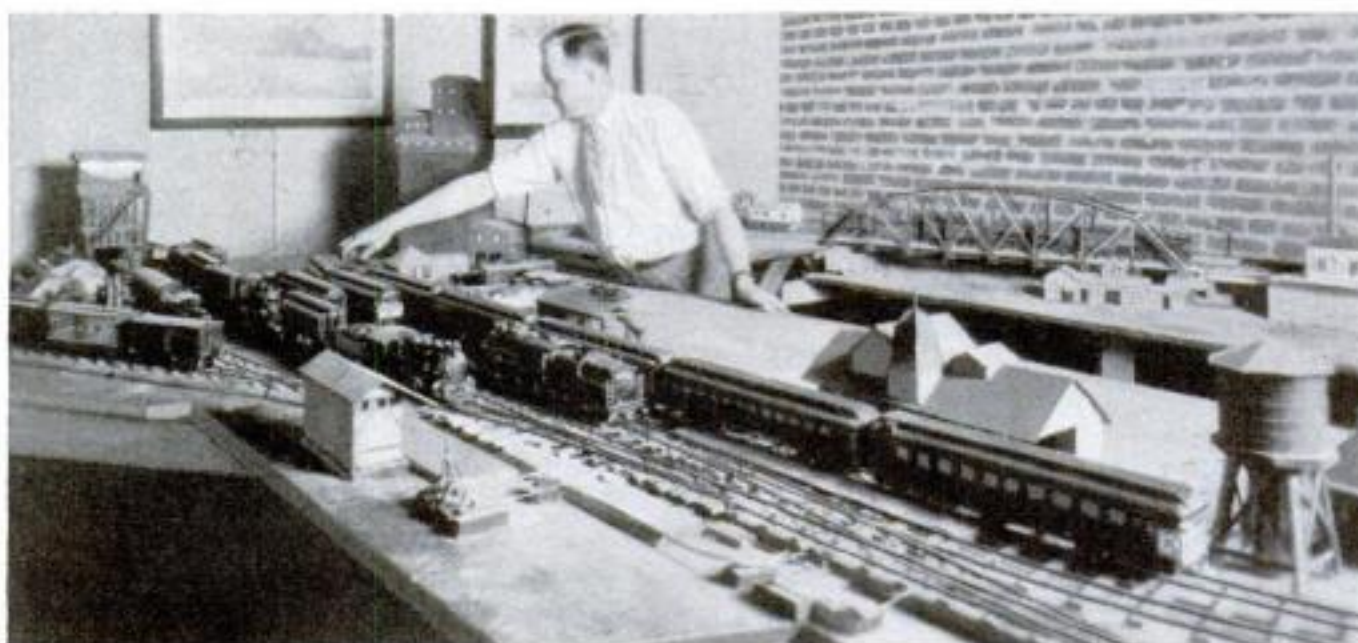
TEST PLANE'S FLUTTER WITH CRAFT IN FACTORY

Test flights to determine the tendency of airplane control surfaces to flutter or shimmy destructively have been made unnecessary by a machine that conducts the tests while the plane is still in the factory. Destructive flutter occurs when the control surfaces vibrate at the same natural rate as the structure supporting them. The new machine makes it possible to test every part of the plane without the hazard involved in taking the ship into the air. A shaft, run by an electric motor, transmits vibrations to the plane's surfaces through springs, as shown above. The speed of the motor is increased by means of a rheostat and, when the surface being tested reaches its natural vibration period, it responds by vibrating in a manner that is easily detected.

SEARCHING Central American jungles for rare tropical insects, a photographer recently made a remarkable series of pictures of the world's most brilliant firefly. The fly is a beetle known to natives as the cucuyo. After nightfall it shines with a brilliance so intense that numbers of its kind are collected in little baskets and used as living lanterns. When, as happens after a time, the brilliance fades, the fireflies are dipped in lukewarm water to restore their light-giving power.

In some Central American cities, they are sold in the market places. Native women buy them to use as ornaments, enclosing them in thin muslin bags which are worn about the neck or in the hair. Part of the insect's light is given off by two waxy lumps on its back. In the dark, these shed an intense greenish-blue light. Another light organ, contained in the back near the tail, is covered by the beetle's wings until the insect takes flight. It then glows as a brilliant red jewel.

ELABORATE MODEL RAILWAY BUILT BY REAL ESTATE OPERATOR

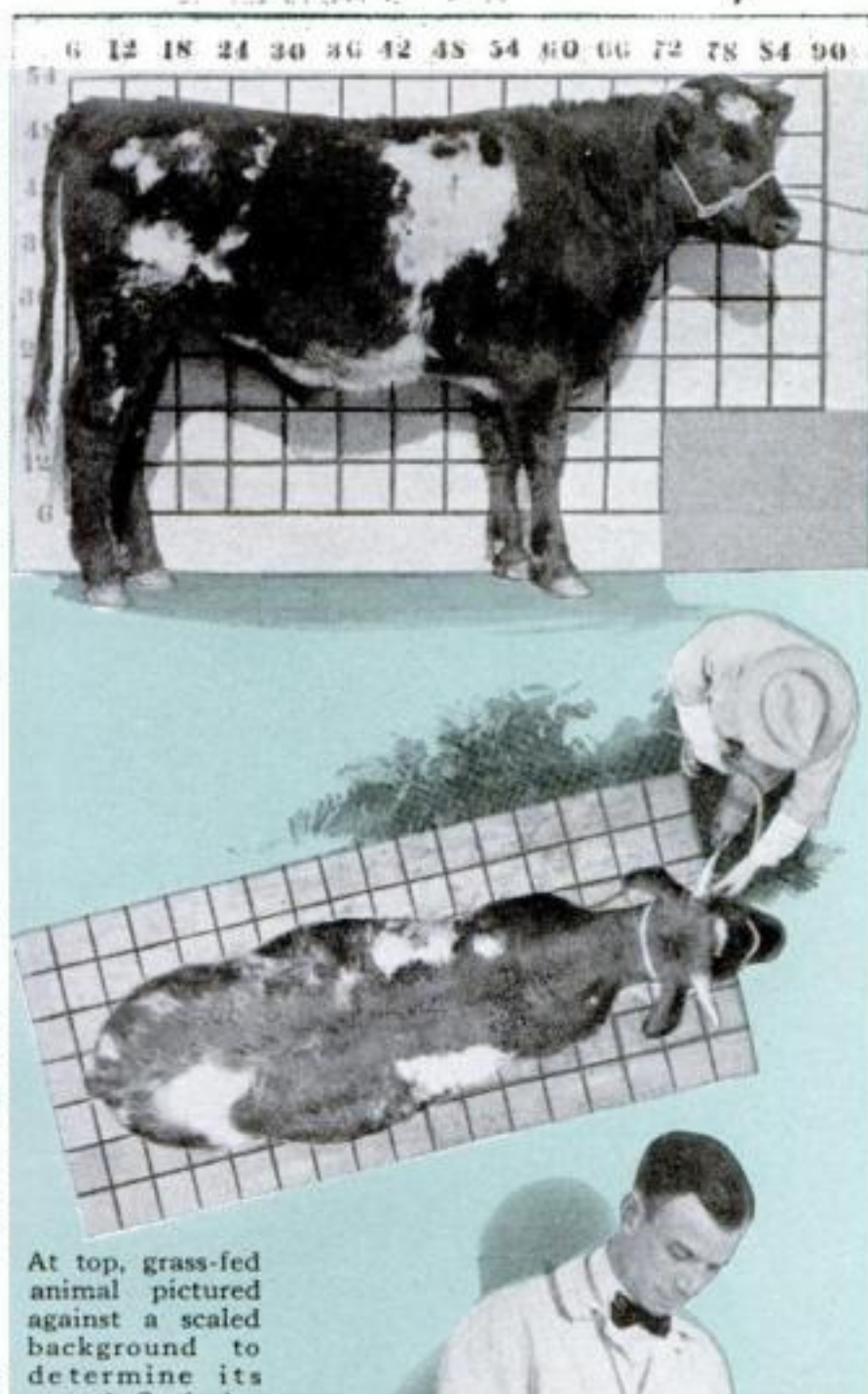


WHEN John N. Swartzell, of Washington, D. C., was studying railroad engineering at the University of Illinois, he enjoyed nothing more than climbing up into the cab of one of the locomotives on the test stands and pulling back the throttle. Swartzell was completely fascinated by his studies and by the prospects of following a railroad career. Then his father, a Washington real estate man, wanted Swartzell to come home and learn real estate. It

was impossible to realize his railroading dreams but he could not forget them. He began the construction in his basement of a complete transportation system. Every bit of the system, track, bridges, rolling stock, building, and all, has been hand-built to scale by Swartzell. The system now includes 700 feet of track, 250 feet of it double. It is wired in three electric circuits, in such manner that two trains can be run at the same time in opposite directions.

NEW PROCESSES
DEVELOPED ON

World's Finest Farm



At top, grass-fed animal pictured against a scaled background to determine its growth. Such pictures are taken every six months. Above, photo from a thirty-foot tower to show the animal's outline

USING as a laboratory the finest stock and dairy farm in the world, a daring group of U. S. Department of Agriculture experts are today at work near a little Maryland town on one of the most ambitious series of experiments ever conceived. Within the space of a few short months they are trying to unravel stock and dairy mysteries that have baffled investigators for centuries. In this work they are using the most modern methods and the finest equipment science can provide, but the greatest factor in their record of remarkable success is the resourcefulness of the experimenters. The problems they are attacking are too obscure and too difficult for cut and dried laboratory methods.

The staggering proportions of the task they faced is indicated by a few of the questions with which they are struggling. Why is a steak from one steer deliciously flavored while another from a steer in the same herd is tough and tasteless? Why will not all cows of the same pedigree give the same quantities of milk? How can the weight of hogs be increased without making the flesh hopelessly fat? How can bees be made to gather more honey?

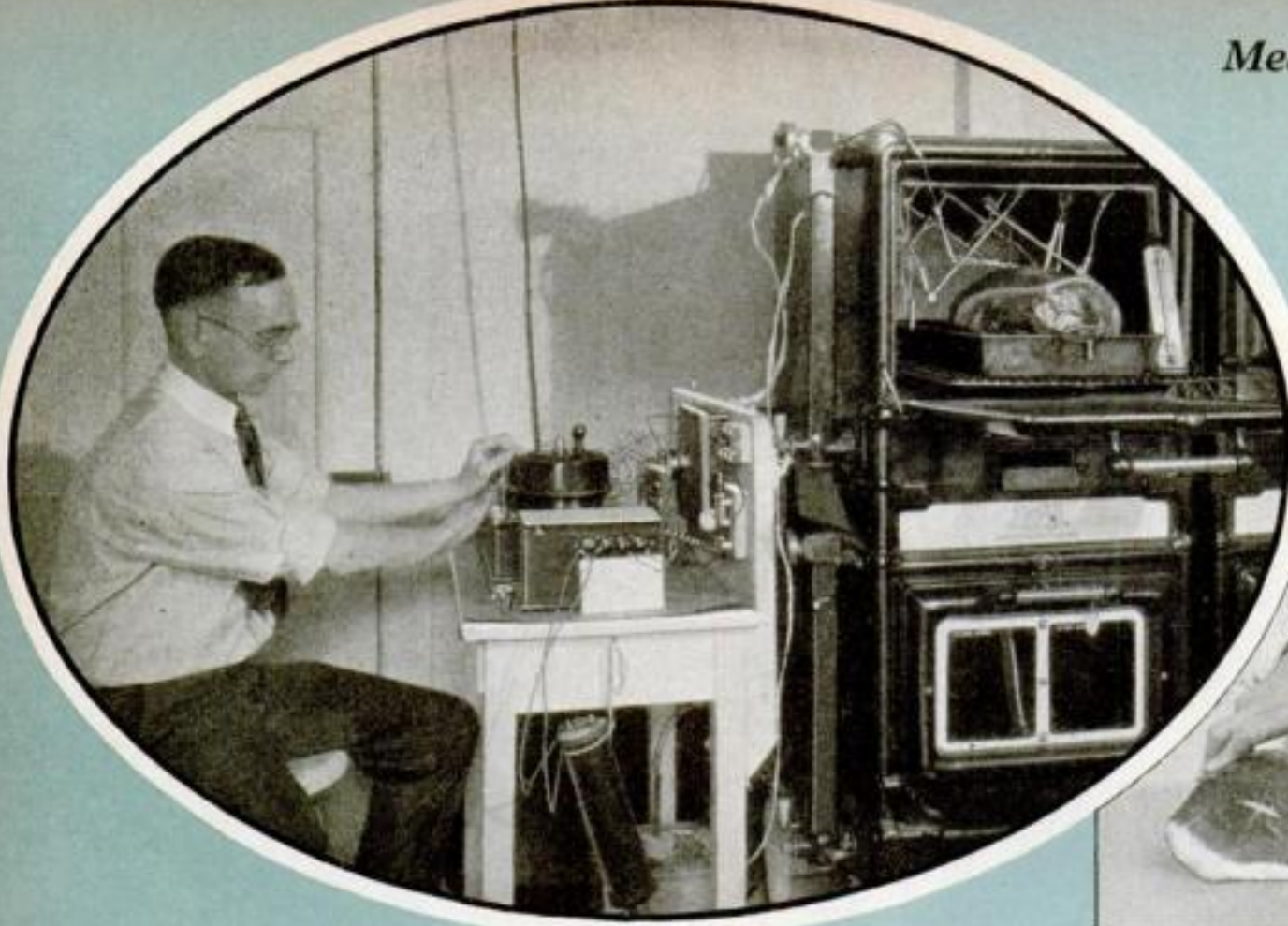
Before answers to any of these vitally important questions could be sought, it was necessary for the experimenters to clear away a confusing mass of tradition and superstition. Outworn theories and costly fallacies were exploded by the dozen and the experts struck out boldly into many fields that had never before been explored. Experiments of such ambitious scope demanded an experimental plant of unprecedented size, equipped with every possible aid. The old Beltsville Farm, near Bladensburg, Md., where earlier work had been carried on, was not adequate to the new needs. As one of the first acts of the present administration, this plant was enlarged and modernized and its staff substantially increased. Additional land was bought until the farm contained 4,000 acres. Roomy stables and barns were built and the farm's herds and flocks increased by the purchase of select animals.

The rearing of a complete slaughter house, including cooling rooms, came next. Then a laboratory was fitted out for chemists, bacteriologists, and experts in genetics. Specialized machines for testing the color and quality of meat were devised and photo-micrograph and X-ray apparatus installed in

By GEORGE H. DACY

Nothing was left to chance in the Beltsville tests. Here a power knife is being used to test tenderness

Meat-Growing Ideas Upset by Government Experts



Left, cooking experimental roasts under standard conditions. The meat is placed in special ovens equipped with electric heat recorders. Below, samples of different quality meats. On the right, meat that is too fat, and on left, nicely marbled sample



One of the prizes of the Beltsville farm is this Persian lamb, produced by cross-breeding. The fur is shown in this picture at its most valuable period

Below, in this splendidly equipped laboratory at the Beltsville Farm, fat is extracted from meat specimens as part of the careful check that is made to find best feeding and growing facts about all livestock



the laboratory. An elaborate kitchen, a court of last appeal in questions of food value, was provided for testing meats for flavor, succulence, and tenderness.

Tests conducted in the kitchen riddled one of the oldest fallacies in the annals of stock raising. Stock men for years had clung to the belief that only by increasing rapidly the weight of steers could they be raised profitably. The government experts, working in cooperation with eleven state experimental stations, raised and slaughtered 3,400 beef cattle to prove animals so raised yielded inferior beef. Meat from quickly fattened animals was compared, by means of the elaborate tests developed at the farm, with samples of meat from animals allowed to mature at a normal rate. Power shears, accurately measuring the pressure exerted, cut the samples to determine their comparative tenderness. Photo-micrographs were taken so that the experts could study the cell structure.

As a conclusive test, the meats were then sent to the kitchen and cooked under identical and carefully controlled temperatures. Experts tasted them and graded them for flavor and tenderness. The verdict favored the normally matured animals.

The consumers as well as stock breeders, the tests showed, delude themselves with rule-of-thumb methods of judging meat. An abundance of fat on a cut of meat is no guarantee of its tenderness. Bright color as a guide to taste was likewise shown to be a myth. Darker meats, all other factors being equal, were

found to be just as tender and tasty as brightly colored cuts.

The only practical way of pre-determining the quality of meat, other studies revealed, is the ratio between the size of an animal and its weight. Roasts carved from scrawny steers were found invariably to be inferior in flavor to those from well-proportioned animals. These facts threw out the old belief that male animals are less desirable as food than females and discredited the strongly entrenched tradition that the character of the animal's diet determines the quality of its meat.

KEEPING a check on the growth and weight increase of steers presented difficulties for the experimenters. A solution was found in a curious measuring scale. A board five feet high and nine feet long was painted with six-inch squares. When a steer is placed before this board, its dimensions can be determined at a glance.

In their search for means of controlling growth and weight increase through selective breeding, the experts delved into practical genetics on a scale hitherto rarely attempted. Fifteen hundred guinea pigs, chosen because of the rapid rate at which they reproduce, are being used at the farm in making preliminary tests before new theories are applied to the meat animals.

Chief among the theories being tested is that of inbreeding. Feeling that this method may hold the secret of producing larger and more robust strains of meat animals, the experts have

inbred one strain of guinea pig for thirty-five generations. Some of the resulting young have displayed a remarkable immunity to tuberculosis and sterility has been practically eliminated from the strain.

Satisfied with the results obtained, the experimenters extended the investigations to hogs. Chester Whites were inbred for six generations and an occasional animal obtained in this way was of astonishing size and yielded pork of high quality. By breeding these outstanding individuals, the experts hope that new strains, more resistant to disease and more desirable as food, can be perpetuated.

In the course of the work on breeding, the fact was emphasized that test-tube matings permit a range of selection previously undreamed of. Although artificial fertilization is an established practice in animal husbandry, it was of necessity localized in application. The experiments carried on at Beltsville Farm have greatly extended the permissible time interval. If the same care that was exercised in the experiments were to be employed in practical application, there is no reason, in the opinion of the experts, why a cow in Florida could not be bred to a sire in Oregon. In this way, stock all over the country would benefit from the improvements being made in cattle at certain breeding centers.

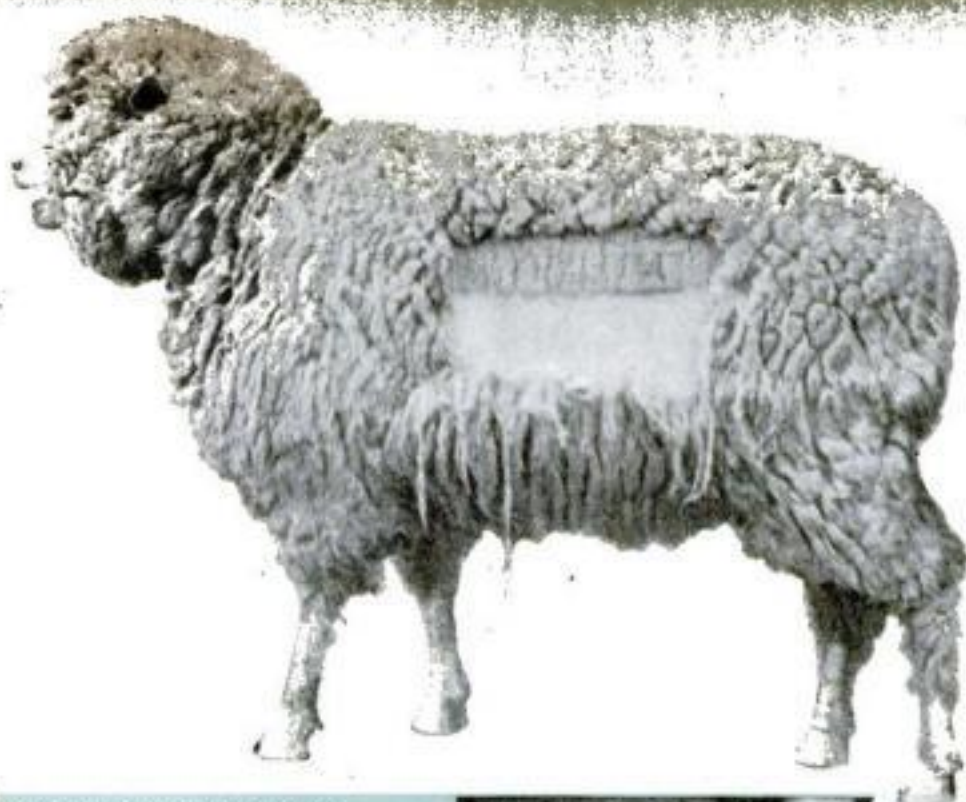
SELECTIVE breeding of honey bees was one of the toughest jobs attacked by the investigators. Queen bees have stubbornly resisted every effort to improve bee strains, as they will mate only on the wing. Artificial fertilization appeared to be the only solution and the Beltsville Farm experimenters persisted doggedly until they finally succeeded in producing test-tube bees. The work is still in the experimental stage, but the men engaged in the task predict that in the near future the Department of Agriculture will be able to distribute queen bees of superior quality, able to produce swarms of workers capable of flying farther in search of nectar and of gathering more of it.

Breeding experiments have extended even to attempts to change the sex of chickens. This is particularly desirable. Roosters do well enough for the dinner table but they are a liability to poultry men engaged in egg production. Attempts to alter the sex of eggs by X-rays failed, but the experts, undiscouraged, turned to a daring new line of attack. They made blood tests of large numbers of birds, and studied the internal structure and functions of the chickens by removing gizzards and other organs. Glass tubes introduced into the chickens' bodies enabled the investigators actually to watch the life processes of the birds. The goal of these strange studies is the perfection of a surgical method that will permit the sex of chicks to be changed after they are born, thus solving a serious problem.

Established feeding practices, as well as breeding traditions, were suspected by the experts. In accord with the widely accepted principle of fattening cattle as rapidly as possible, stock men commonly feed grain to the cattle during the later stages of the fattening process. The fatty tissue accumulated during these stages did not, previous tests had shown, improve the quality of the beef. The only effect of the grain, therefore, was to swell the cost of raising the stock and cut the anticipated profit.

To prove their point that grain feeding was wasteful, the Beltsville Farm investigators produced beef of excellent texture and flavor without feeding the cattle an ounce of grain. They selected a number of steers and kept them on a diet of grass exclusively, giving them hay when they were not on pasture. Ribs cut from steers so fed analyzed as high in fat as is desirable in well-flavored beef. The flavor of mutton from sheep fed entirely on grass compared well with cuts from grain-fed animals.

Such feeding experiments as these require immense quantities of hay. In storing the hay at Beltsville Farm, the experimenters encountered the menace of spontaneous combustion, a phenomenon responsible for the destruction of *(Continued on page 117)*



This experimental sheep gives up wool samples at frequent intervals as experts strive to discover secrets of feeding and wool growth. At right, tying colored strands to living wool so its growth may be easily measured

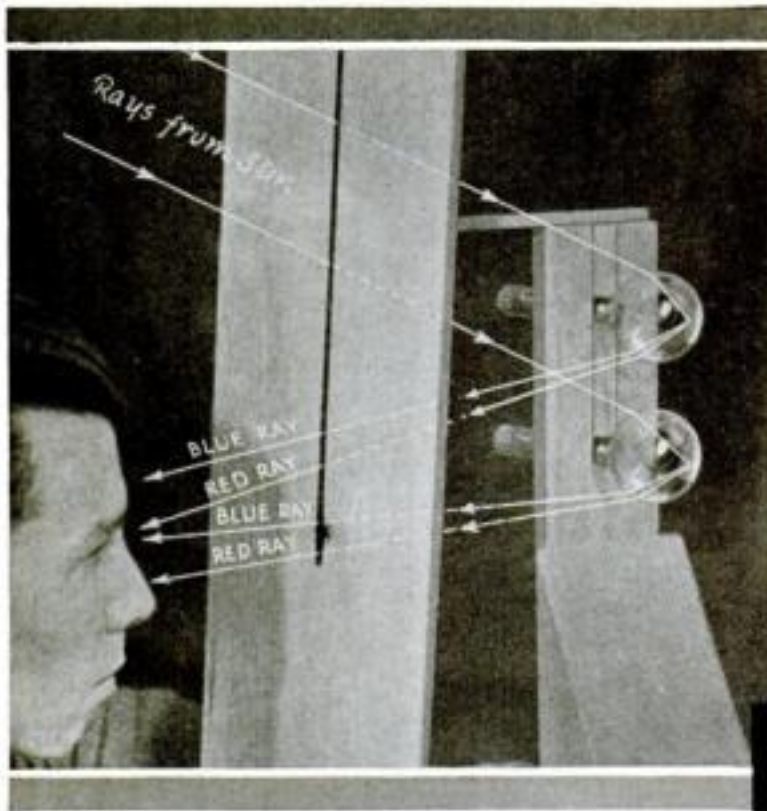


At left, an expert busy at the delicate task of artificial insemination of a honey bee. In this way bees have been produced that fly farther, live longer, and work harder than do the ordinary kind. This is expected to prove of great value to bee keepers

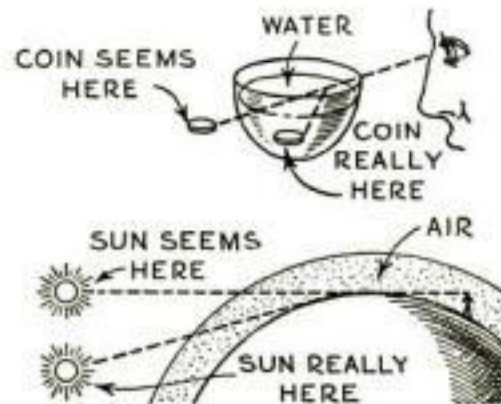
Below, experimental guinea pigs inbred for thirty-six generations. They have thus become immune to tuberculosis and other diseases and various desirable characteristics have been developed. At right, the power-driven whirligig in which a guinea pig is placed and forced to take its regular exercise



Rainbows and Sun's Green



Arrange a slit, as shown, through which the sunlight can fall upon a drop of water. Then when you look through the same slit at the water, a rainbow will be apparent. The white lines, showing how the rays are reflected and refracted, make clear why a rainbow is seen. At right, illustration shows course of sun's rays through a single drop of rain to form rainbow

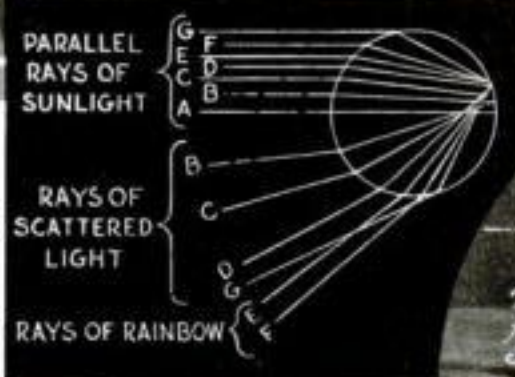


A cup containing a coin is held so the money is invisible. When water is placed in the cup, the coin is plainly seen. This is due to refraction of light. Thus the sun can be seen while below the horizon

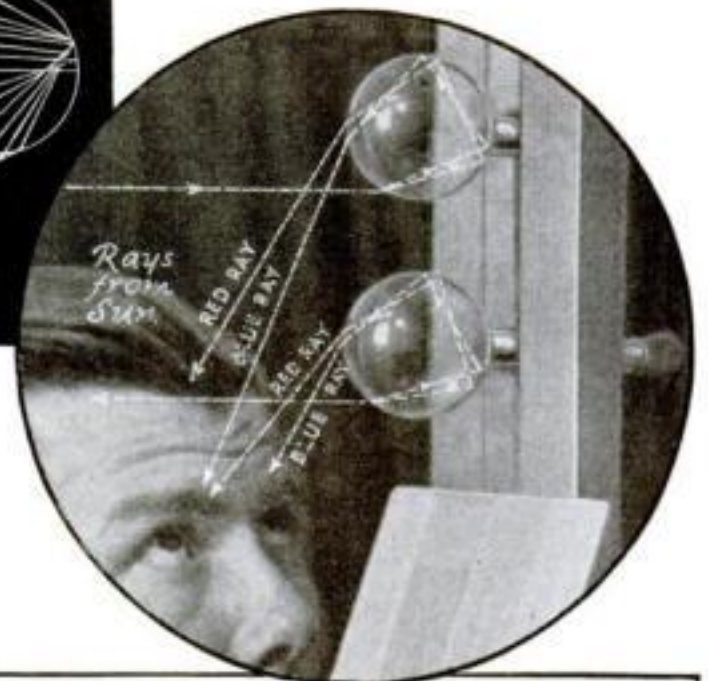
through the water of raindrops. Since the green flash is simpler to explain and helps to understand the rainbow, let's start with it.

Everybody is familiar with the little optical experiment which proves that light is bent when it passes from a dense to a less dense medium. A coin is put into a tea-cup and the observer lowers his head until the coin is hidden by the rim. Then, without moving the eye, water is poured in and the coin is suddenly seen by light which is bent around the cup's edge by refraction from water to air.

Something similar occurs every evening at sunset when the sun's light passes to our eyes through



Right, illustration shows the position of observer's eye which is necessary to see the secondary bow. Below, the reason why it is impossible for two persons to see the same bow is made clear. Inset shows why bow is not seen if the sun is more than forty degrees above the horizon



By GAYLORD JOHNSON

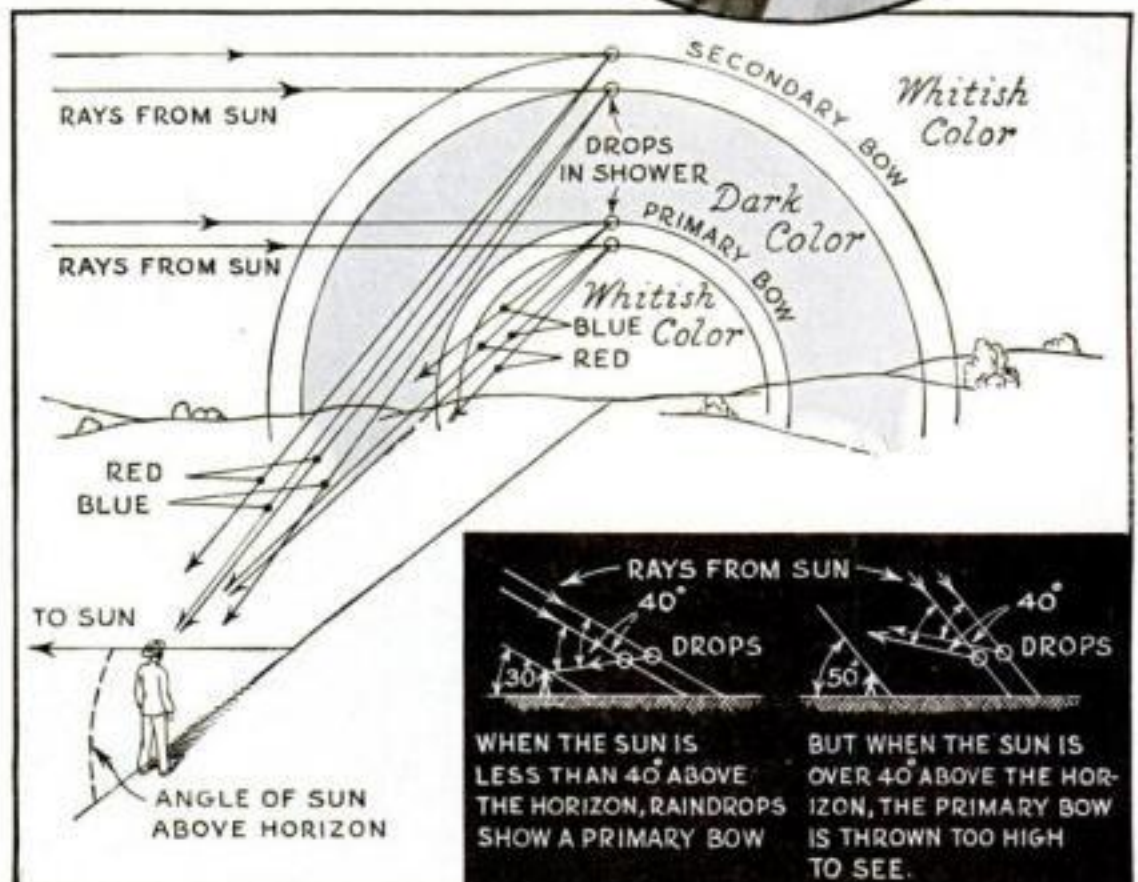
FEW people realize that the famous green flash as well as the marvelous color effect called the rainbow, is explained by a principle which can be demonstrated indoors with the simplest of laboratory materials. In fact, not many persons have seen the green flash at all, either at sunset or sunrise, although it occurs frequently at sea or on land when the sun rises or sets in a clear sky on a level distant horizon.

The reason for the general ignorance of the green flash lies, of course, in the brief duration of this beautiful and puzzling phenomenon. It lasts generally from one fifth to one half a second.

If the smoldering red setting sun suddenly turned to emerald green and remained green for three or four seconds, the fact would be so generally known as to cause little comment. It requires a good observer to see the emerald flash, sometimes as brief as the green twinkle of the Dog Star, unless he has been told what to look for.

I had seen the sun rise and set for years, in various parts of the world, without being conscious of the green flash. But once I knew what to look for, I saw it frequently during a few weeks of watching.

Both the green flash and the rainbow are caused by the refraction of light rays. The first, when light passes through the earth's atmosphere, and the second when light passes



EXPLAIN

Flash

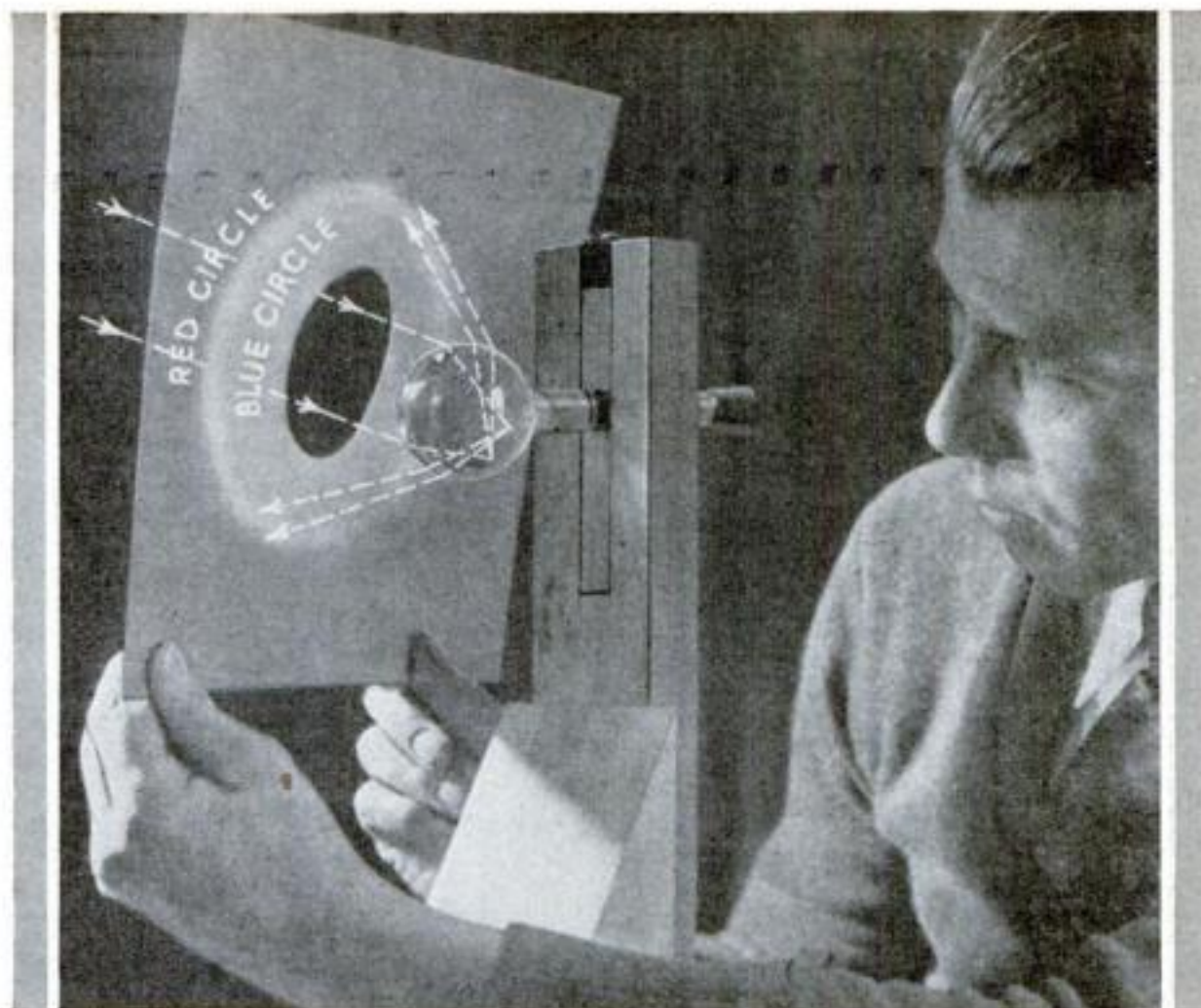
increasingly dense layers of atmosphere. Due to the bending of the rays which this causes, we actually see the sun below the rim of the horizon after it really has set.

With this point clear, we are ready for the beautiful experiment that enables you to reproduce the green flash with an ordinary electric bulb in place of the sun and some kind of a prism to represent the earth's atmosphere. The dangling prism, from an old-fashioned chandelier or lamp, will do perfectly.

As you raise the prism, edge up, the edge becomes the horizon below which the lamp-sun sinks. Even after this luminary is no longer seen in a direct line, it is visible by rays which are bent through the prism-atmosphere. Owing to the unequal bending of the variously colored rays by the prism, the eye really sees several closely overlapping colored images of the lamp bulb—the upper blue, the next green, and so on down to orange and red at the bottom.

As the hand of the observer continues to raise the prism, at the same time rotating it toward the eye, the lamp is seen to become narrower and wider and the colored images disappear at the lower edge of the prism, beginning with the red and orange and finishing with the green and blue. These are the last to vanish as the hand continues to turn the prism away from the lamp, just as the green image of the sun is the last one seen when the earth's atmosphere is turned away from the sun at sunset.

You can make the green sunset flash as short as you like by turning the prism more rapidly. By reversing the rotation, turning toward the lamp, you can duplicate the appearance at sunrise. In this



In this experiment, sunlight falls through a hole in a piece of cardboard and strikes the glass globe. The rays are then reflected and refracted as when light shines upon a raindrop. This illustrates how the circular spectrum is thrown by each raindrop.

case the blue and green edge of the lamp-image appears first, followed by the lamp itself and then its orange-red edge.

In this experiment, you see the blue and violet quite clearly, but in Nature these colors are quickly absorbed by their long journey through the earth's atmosphere, leaving the more vivid green as the most prominent color to be seen in the flash.

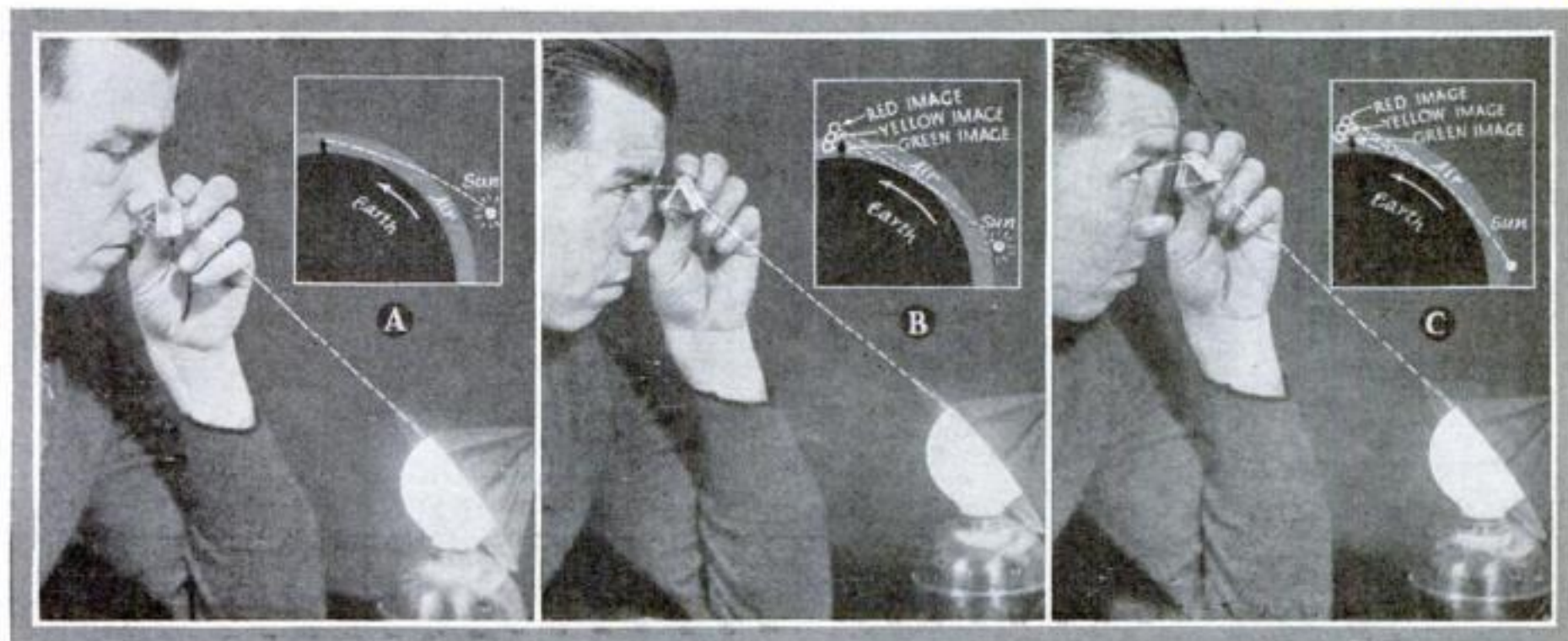
You may sometimes be told that the green flash is merely an after image or complementary color image. In other words, that you naturally see a green flash after the sudden disappearance of the red sun at which you have been looking. This assertion is of course disproved by the fact that the green flash is observed at sunrise. When the green appears before the red sun, as it does, there

is no chance for a complementary color image to be formed on the eye's retina.

Also, the green flash has been observed when using heliograph signals at night with artificial light, across a distance of nearly fifty miles. At this distance, atmospheric refraction carried the light over the edge of the horizon and showed the green flash at a certain point down a hillside, just below the place where the heliograph flashes were being received.

When you observe the green flash in nature, however, it is well to avoid looking too steadily at the sun until it has almost completely vanished over the horizon. Otherwise you may for some time see a complementary color image of green wherever you look, and mistake it for the true green flash.

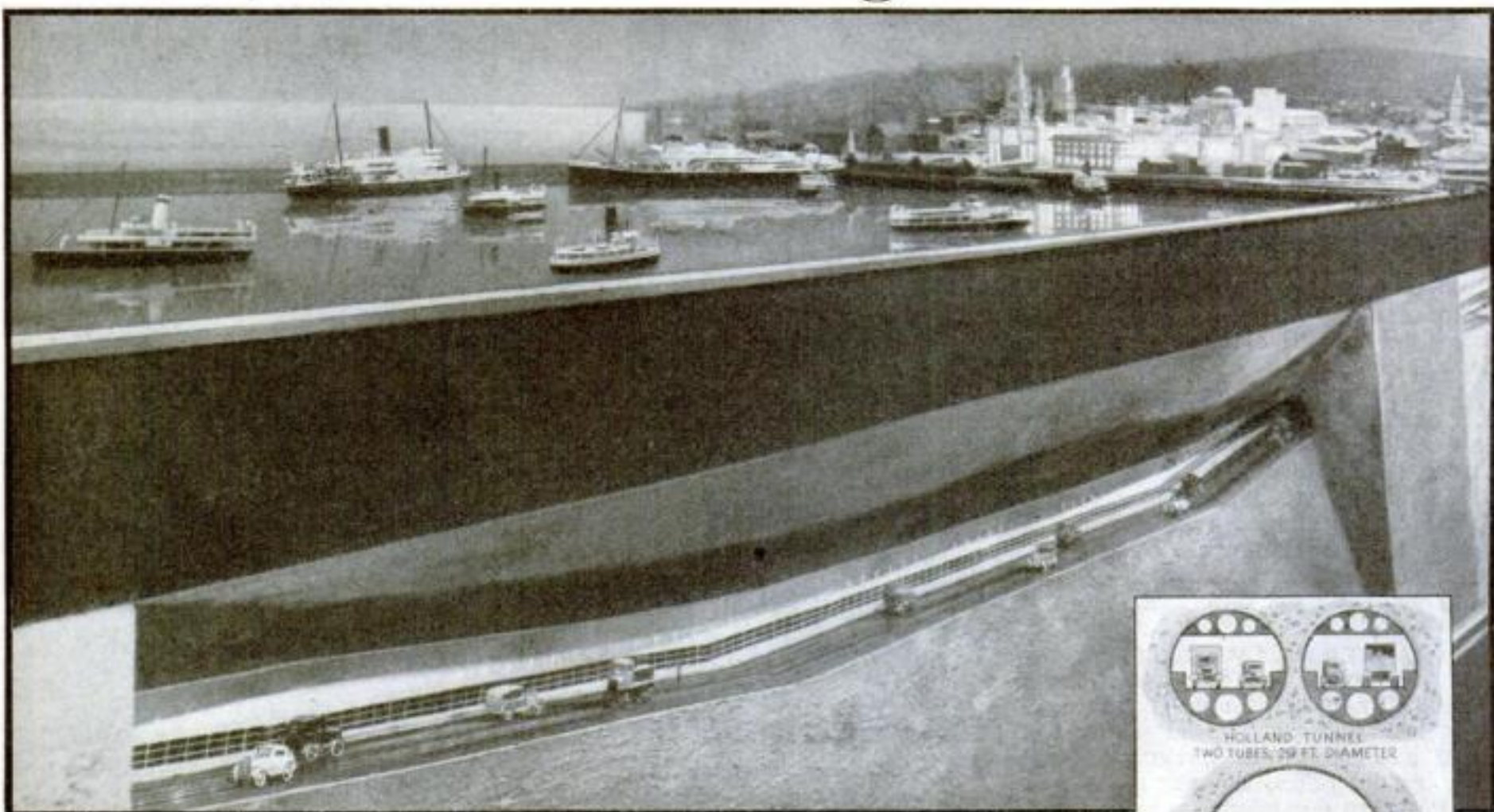
The other *(Continued on page 118)*



By using a prism, as shown in the illustrations above, the green flash can be made artificially. First, A, look down at frosted lamp bulb, the sun, over the prism which represents atmosphere

Then turn the prism toward you, as in B, until the colored image of the lamp is seen. Keep turning the prism until all the colors but green vanish. At that point you see the green flash

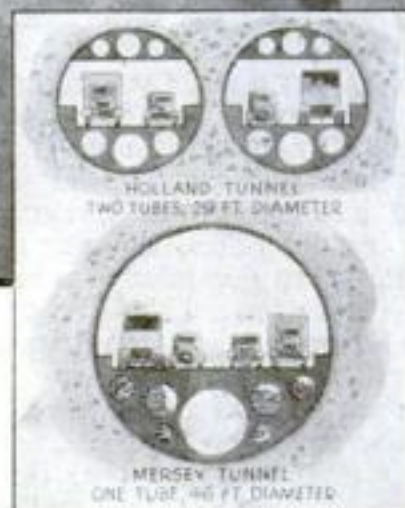
Model Shows Course of Big Underwater Tube



ONE of the most elaborate models ever constructed was exhibited recently at Liverpool, England, as a feature of the ceremonies marking the formal opening of the Mersey River tube. This underwater tunnel, the largest ever built, carries vehicular traffic between Liverpool and Birkenhead. The model showing its course beneath the river is twenty-eight feet long and twelve feet high. Twenty-six men spent eight months building it. In size, the actual tube dwarfs the Holland Tunnel under the Hudson River at New York. Two and one seventh

miles long, the Mersey tube is forty-six feet, three inches in diameter. The Holland Tunnel's length is one and three fifths miles and the diameter of each of its tubes is twenty-nine feet, six inches. The Mersey underwater roadway is thirty-six feet wide, accommodating four lanes of traffic. At either end of the tunnel, these lanes divide into pairs and reach the surface through two portals on each bank of the river. The tunnel is paved with cast iron, the longest stretch of such roadbed

Above, remarkable cut-away model of world's biggest underwater tunnel at Liverpool. Right, cross section compares it with Holland tunnel



in the world. The four traffic lines are marked by blocks of compressed rubber which project slightly above the level of the driveway. The inside of the tunnel, to a height of six feet, is lined with black glass. Giant pillars for lights have been built at each of the four entrances to the mammoth tube.

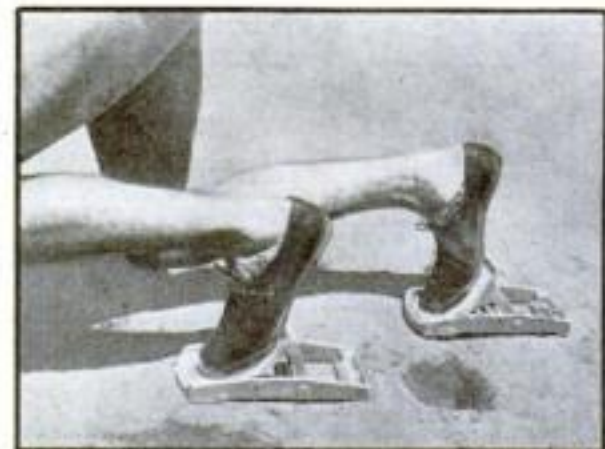
BRIDGE PILES ARE SCREWED INTO PLACE



GIANT screws of wood are being used as piling for a foot bridge at an Iowa lake resort. Hardwood timbers, from ten to twelve inches in diameter at the top and tapering to six inches at the tip, are cut so that threads are formed for several feet back from the tip. In this way the timbers are transformed into immense screws. The piles are then twisted down into the clay to form firm supports.



Above, giant screws formed by cutting threads in the end of hardwood piling. At top, the manner in which the piles are twisted into the ground to form supports for foot bridge at lake resort



ALUMINUM BLOCKS GIVE SPRINTERS FAST START

ADJUSTABLE aluminum starting blocks, invention of Everett F. NiDay, athletic director at Pasadena Junior College, Calif., are designed to help sprinters get away fast. Providing inclined studded plates against which runners may obtain a firm footing, the new blocks supplant the old practice of digging toe holes in the track. Spikes attached to the under side of the brackets that support the inclined plates keep the blocks firmly in place. The inclined plates can be adjusted to suit the natural position of the runner's feet.



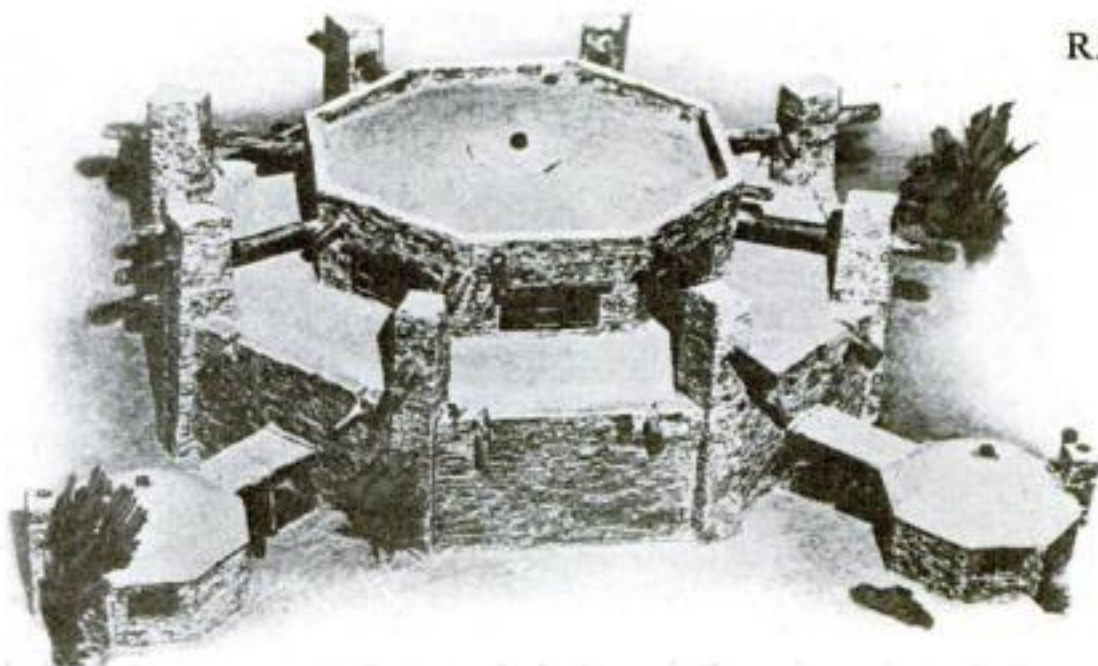
ELECTRIC PENCIL PUTS MARK ON CAR'S TIRES

WITH a new form of electric pencil, a car owner can keep a check on his tires. The device operates from any light socket and provides a burning-hot writing point. When a tire is placed in service, the owner inscribes on it the mileage reading of the car's speedometer and the date. Exact data regarding the performance of the tire thus is available at any time.

NEW ROBOT TIMER TURNS RADIO SET ON AND OFF

WITH an automatic timing device recently patented by a Washington, D. C. inventor, a radio fan may listen to his set all evening without once hearing an advertising talk. Before a program starts, the listener pushes one or more of the six buttons with which the device is equipped. The synchronous motor in the instrument turns the radio set off automatically at the periods between programs and turns it on again after a lapse of time.

Pressing the keys in this device sets it so it automatically turns radio off and on at the intervals chosen by listener



OLD AND NEW MEET IN INDIAN HOME

A CURIOUS admixture of ancient desert architecture and twentieth century comforts is found in the new houses being built by Navajo Indians on their Arizona reservation. The walls of the dwellings, like the walls of the oldest Navajo houses, are adobe. The roofs, however, are made of

modern, waterproof material in place of traditional wattle, and the windows, instead of being mere interstices in the walls, are glazed and have steel sash. As a final touch of modernity, the houses are equipped with steam heat. The Public Works Administration is providing the money.

RADIO-PHONE SPEEDS BRIDGE WORK

THE first radio-telephones ever used on a construction job are speeding work on the eight-mile-long Bay bridge from San Francisco to Oakland, Calif. Using the phones, engineers at headquarters in San Francisco can dispatch orders instantly to any point on the job. Sending messengers by boat to men at work on the piers and barges and on the Oakland shore would take as long as forty minutes. A small switch built into the telephone sets is moved to send out call signals and to permit the reception as well as the transmission of messages. In this way no time is lost in transmitting orders.

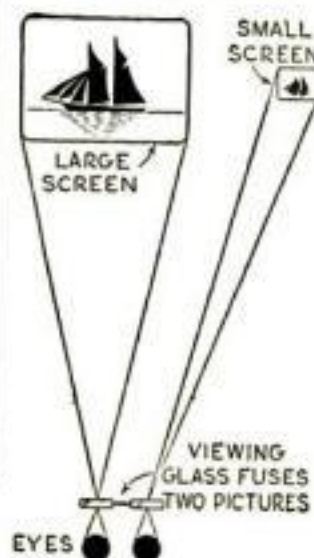


TWO PICTURES AT ONCE GIVE MOVIES THIRD DIMENSION



Demonstrating the principle of three-dimensional moving picture method. A large picture is seen with one eye and a small one with the other

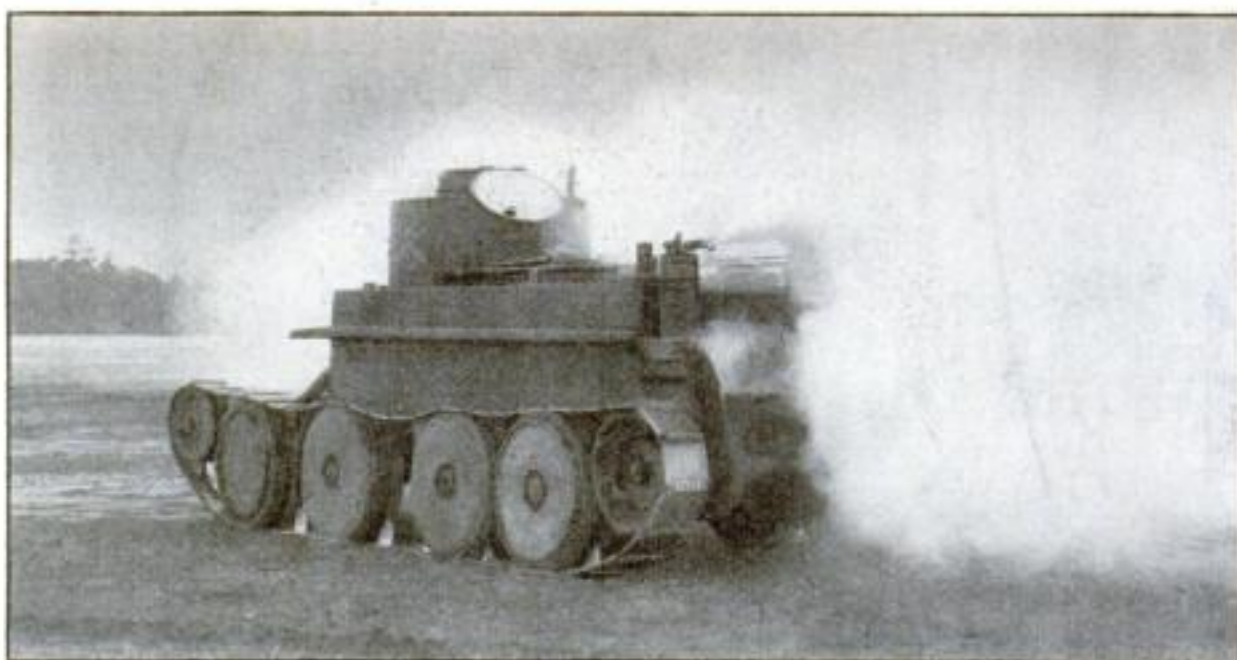
Diagram shows how the new method could give depth to movies



A NEW way of giving pictures an effect of depth, has been devised by a Bridgeport, Conn., inventor, who foresees its application in the movies. His method provides a miniature picture that is viewed with one eye, while a full-sized picture is viewed with the other. Since the two pictures are taken from slightly different viewpoints, a stereoscopic effect is obtained. The advantage of this method when applied to motion pictures, he points out, is that a theater patron may view a movie either in the ordinary way or with added depth, as he chooses. The large picture would be projected upon a standard screen, while the small picture would be projected upon a small screen. To view the film in three dimensions, the patron uses a viewing glass which enables him to see the large and small pictures fused together.

ARMY'S NEW TANK LAYS DOWN SMOKE SCREEN

A TANK that lays down a dense, protecting screen of smoke before lines of advancing infantry is the latest offensive weapon developed by the U. S. Army. Capable of good speed over shell-torn ground, the tank, equipped with smoke-generating apparatus, darts out ahead of the attack and lays a thick cloud of white smoke before the enemy's line. The attacking infantry can then advance under cover of the smoke without being subjected to directed fire from the enemy. After having laid the screen, the tank can then take up its ordinary duties of attacking machine gun nests. Running on its tracks the tank is said to be capable of twenty miles an hour.



Army's new tank which is capable of laying down a smoke screen behind which the infantry advances

DENTAL PATIENT CAN GIVE HERSELF GAS



New apparatus enables dental patient to give herself gas

DENTAL patients can now administer their own anesthesia. The gas, the same as that now used by dentists, is a mixture of nitrous oxide and oxygen. A tube leading to the tanks containing the gases is equipped with a pistol-like control. While wearing a mask, a patient with this control can release as much gas as she needs to overcome the pain. The patient does not lose consciousness but suffers no pain.



CAR DRIVER CAN NOW FLASH SIGN FOR HELP

ATTACKED by hold-up men or kidnapers while in his car, a driver using a Detroit inventor's new alarm signal may appeal to police or passing motorists for help. The signal is lettered with the word "Help." When not required, it folds up out of sight. When danger threatens, the driver pushes a button and the signal drops down into plain view.



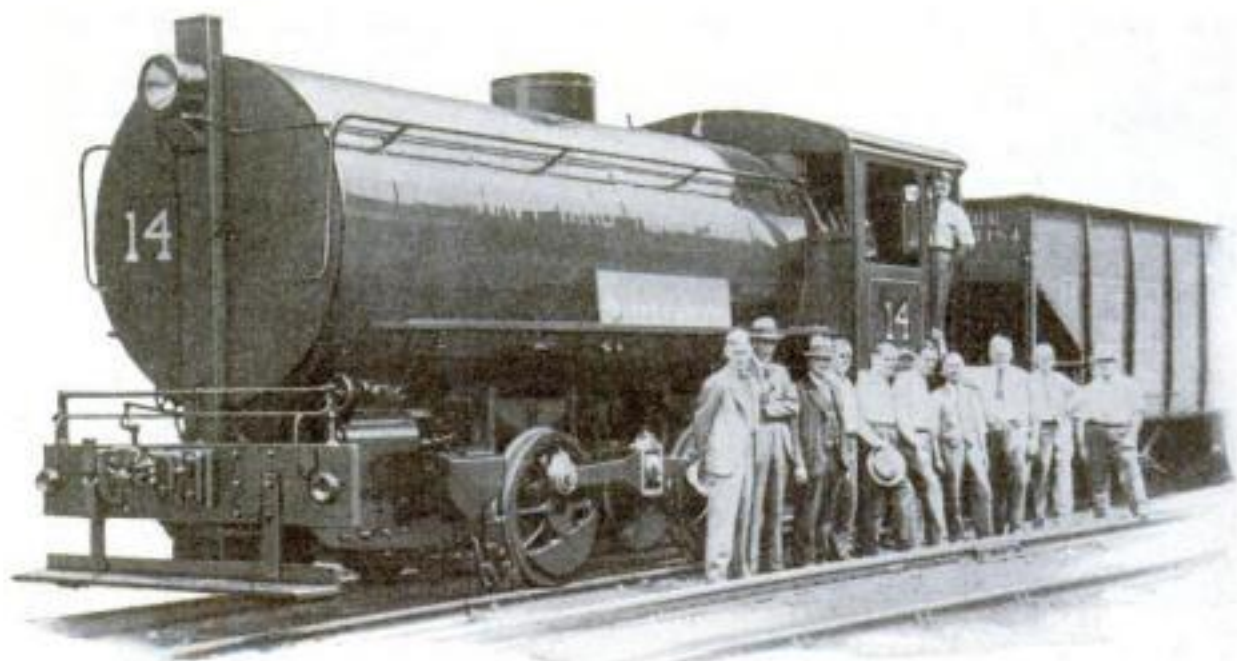
STUDY FIRE FIGHTING IN MODEL BUILDING

SEEKING methods of clearing a burning building of smoke and gas so firemen may enter, San Francisco firemen recently built a miniature five-story building to study the behavior of flames. The building was constructed of brick, concrete, and steel and one side was fitted with glazed doors to represent windows. Openings in the floors simulated stairways and elevator shafts. Lighting fires on various floors, firemen opened one or more doors at a time to note the effect of the ventilation. The tests showed that no windows should be opened in a burning building.

STORED STEAM RUNS FIRELESS ENGINE

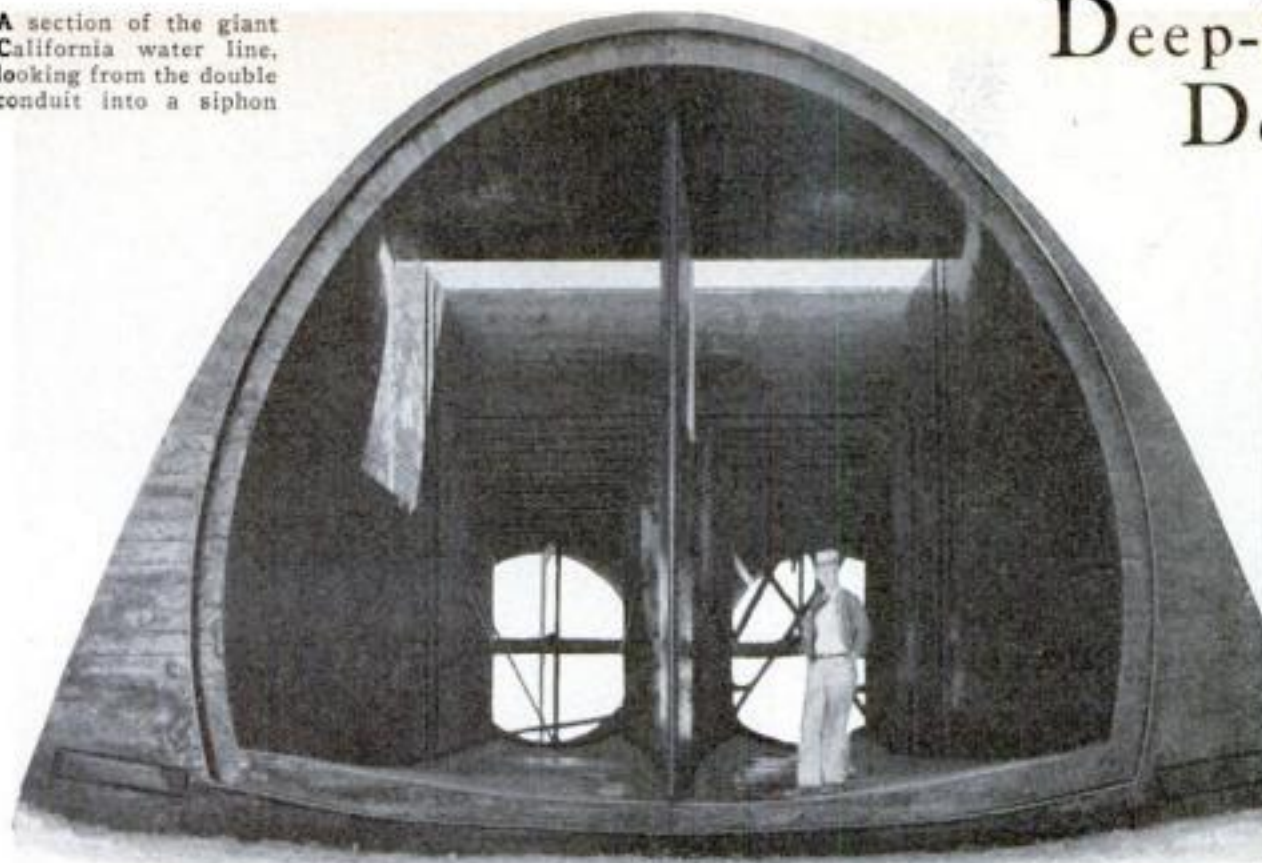
THE Brooklyn Navy Yard will soon place in operation the largest fireless switching engine ever built. Containing no firebox and no boiler, it runs on stored steam. A huge tank, resembling the boiler of an ordinary locomotive, is periodically filled with steam from a stationary plant. A steam pressure of 200 pounds is built up at the time of charging, and the switcher will operate without appreciable

loss of pulling power until the pressure falls below fifty pounds. This drop does not usually occur for several hours. The charging operation consumes about twenty minutes, less time, it is estimated, than is required for a conventional locomotive to take on coal and water and clean out the fire and ash pans. The engine is at present undergoing its final tests and is expected to prove highly efficient.



Largest fireless switching engine for use at the Brooklyn Navy Yard. It is run by stored steam

A section of the giant California water line, looking from the double conduit into a siphon



Deep-Sea Diver Tests Desert Water Line



Burying a section of inverted siphon in a large trench on the edge of the desert. Below, taking measurements of the "give" of a mammoth siphon

OCEAN diving in the heart of the desert was the novel experience of William Saylor, an engineer engaged in making strain tests of newly completed sections of siphon and conduit for the Metropolitan Water District of southern California. With a diving helmet made from pieces of scrapped galvanized iron and a paint spray gun driven by a one-fourth-horsepower electric motor supplying air, Saylor remained under water for periods of five hours. The diving took place in two 700-foot sections of concrete conduit and siphon. Each, sixteen feet in diameter, had been filled to its normal flow depth of thirteen feet. Then the engineers measured its resistance to this great strain by means of an extensometer, a device whose length is not affected by heat or cold. It consists of an invar tape on the end of which is a dial graduated to measure changes in the huge pipe's diameter to one thousandth inch, and a

spring balance to measure tension on the tape. With it were measured the diameters before water was pumped in, while filled and after emptying. The pipes were found to "swell" about one tenth of an inch when filled. Though workers outside were sweltering in the desert heat, the diver reported via telephone that he enjoyed cool autumn temperature while below. With the crude home-made helmet, to which was fixed a rubber cape fitting down on his shoulders, he could walk on the bottom of the giant tubes and bend over at will while going about his task of making the delicate measurements beneath the water.



MYSTERY TOWERS SURROUND PARIS



MYSTERY cloaks several mastlike towers recently erected at the St. Denis railroad station outside Paris. Perching on top of each tower, like a giant bird house, is an enclosed platform containing a searchlight. It is explained that the lights will be used to illuminate the railroad yards, but the height of the towers and the power of their lights have led to the belief that they are part of the elaborate air defenses of Paris and will be used for observation purposes in time of war.

NEW METAL BARREL OPENS EASILY



DESIGNED to hold lard, condensed milk and other food products, a new type of refillable steel barrel can be opened quickly without the use of tools. The locking ring that holds the removable head of the barrel tightly in place is fitted with a short lever. Lifting this lever spreads the ring and permits the head to be removed by means of a small wire handle. A gasket is fitted between the head and the barrel to prevent leakage. An ingenious arrangement makes it possible to padlock the barrel as protection against tampering or adulteration of the contents.

The opening and closing of this barrel is made easy by the use of a simple locking ring. Picture at left shows the parts needed. Right, locking lever in action



Glass Making



PRODUCING SILICON. Sand is reduced with magnesium powder in a porcelain crucible to form either silicon or magnesium silicide. The ignition that occurs, though vigorous and spectacular, is harmless

into a small beaker of water. Hydrochloric acid then should be added and the resulting liquid filtered. The silicon freed by the reaction will be left on the filter paper in the form of a grayish powder. Like the coke in the commercial process, the magnesium powder acts as a reducing agent, which robs the sand (silicon dioxide) of its oxygen. The hydrochloric acid is added to dissolve the magnesium oxide formed by the reaction, leaving the silicon free.

Through the use of alkalis, the home chemist can perform other interesting experiments in which sand is torn apart to form new silicon compounds. For instance, by fusing sand with sodium hydroxide (lye) or sodium carbonate (soda ash) and leaching out the products, sodium silicate can be formed. The home chemist may recognize this chemical more readily by

glass will result. By adding metallic oxides to the mixture, however, the glass can be colored to correspond with the metal used. Cobalt, for instance, will impart its characteristic blue color while copper or selenium will color the glass red.

Incidentally, a handy tool for lifting crucibles and other hot containers can be made from an inexpensive serving fork of the type having a finger that can be moved to push meat or vegetables from the tines. Simply cut off a portion of the prongs and the movable finger and bend them as shown in the illustration.

By duplicating the first experiment, in which pure silicon was prepared, in a slightly modified form, another useful chemical—magnesium silicide—can be produced. The two processes differ only in the amount of magnesium powder used. In this experiment, the magnesium and sand should be mixed in the proportions of two to one by weight (instead of one to two) to provide an excess of magnesium.

Grind the sand as before and add the magnesium powder. Then place the mixture in the crucible and again cover it with a sheet of tin. Although, as before, the cover should not be clamped in place, it can be a tighter fit. Heat the mixture to start the reaction. When it is completed, examine the crucible carefully. The magnesium silicide it contains can be scraped out with a knife and bottled for future use.

BECAUSE of its importance in glass making and other industries, silicon opens a particularly interesting experimental field to the home chemist. In nature, silicon is almost as plentiful as oxygen. Yet, it hides itself well in its compounds. It never is found free and uncombined and can be separated from its associates only through clever chemical thievery in the laboratory.

Industrially, silicon is obtained by heating sand—a compound of silicon and oxygen—and coke to a high temperature in an electric furnace. The white-hot coke steals the oxygen from the sand to form carbon monoxide and frees the silicon. Although the amateur chemist will have no electric furnace in which to duplicate this process, he can obtain a similar result by heating sand and powdered magnesium over his ordinary laboratory gas burner.

First grind some pure white sand in a mortar and mix the powder that results with about half its weight of powdered magnesium. Place the mixture in a small crucible and cover it with a sheet of tin to exclude the air. The cover should not be clamped on but merely rested in place. Finally, heat the crucible with the blue flame of your burner. Soon after the heat is applied, the magnesium in the mixture will burst into flame. This will increase the temperature until finally the entire mass will glow brightly. The reaction that takes place will be vigorous and spectacular but entirely harmless.

When the flame has subsided, allow the crucible to cool and dump its contents

SILICON AND BORON

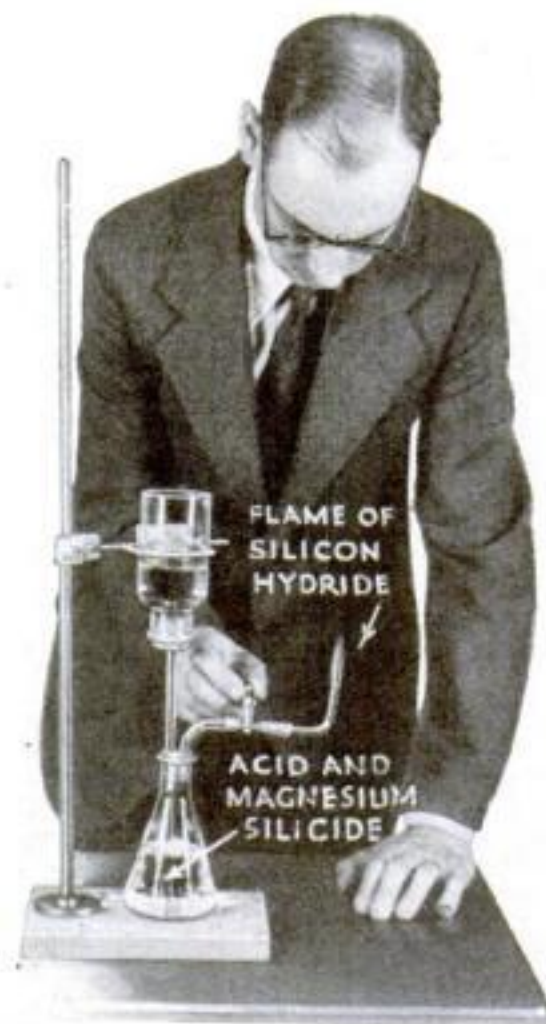
Silicon and its brother element, boron, provide many interesting experiments for the home chemist. Besides its unusual properties as an element, silicon holds a very important place in industry as a constituent of glass. This article tells how to produce silicon and several of its compounds, and to perform experiments that are both spectacular and full of interest

the more familiar name, "water glass."

When sand is fused with limestone and sodium carbonate, glass results. Again, because of the comparatively low temperature developed by the laboratory gas burner, the amateur may find it difficult to prepare glass from these three chemicals. However, by using sand, sodium carbonate (or bicarbonate), and lead monoxide (litharge), he should be successful in producing enough glass beads to demonstrate the process. The crucible should be porcelain.

A mixture of equal parts of sand, sodium carbonate, and lead monoxide should be placed in a crucible and heated over a gas burner until a clear white or yellowish liquid results. This liquid will be molten glass and can be formed into tiny beads by pouring it onto a tin bottle top and allowing it to cool.

If plain white sand is used in preparing the mixture, colorless or slightly yellow



SILICON HYDRIDE GAS
The gas is generated in this simple little apparatus and ignites upon reaching the air

Easy for Home Chemist

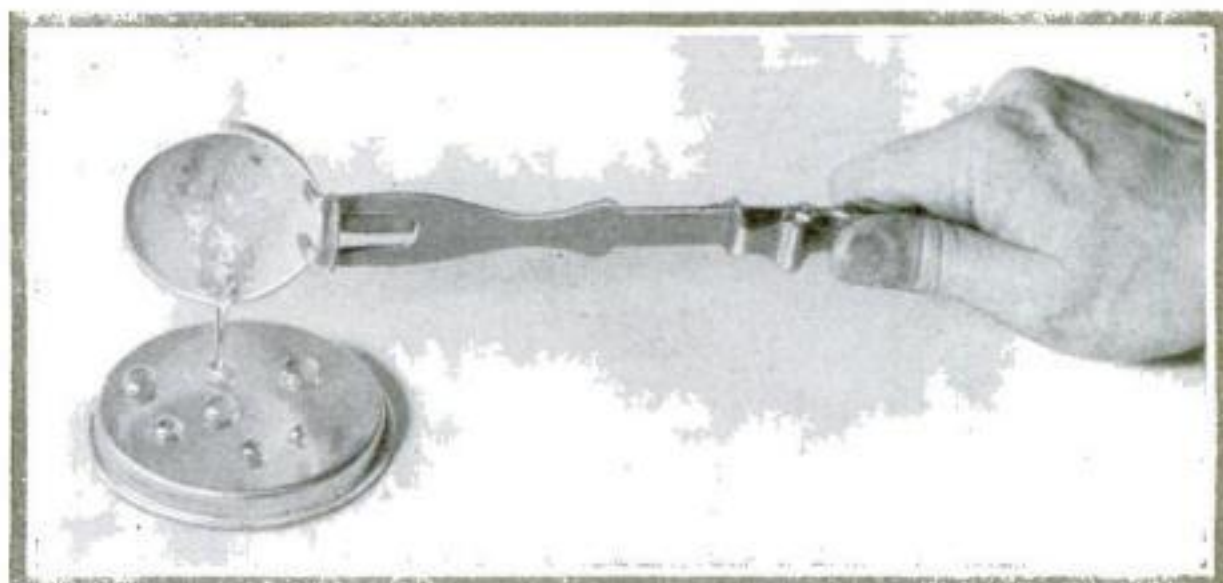
By

RAYMOND B. WAILES

A combination of silicon and hydrogen, called silicon hydride, can be prepared by adding hydrochloric (muriatic) acid to a small quantity of the magnesium silicide you have made. The product, a mysterious gas, is particularly interesting because it ignites or explodes spontaneously as soon as it is released in the air.

To demonstrate this harmless spontaneous reaction, the home chemist should arrange a simple generator consisting of a glass flask, a two-hole stopper to fit, some glass and rubber tubing, a funnel or reservoir made by cutting the bottom from a bottle, and a pinchcock. The apparatus should be arranged as shown so that water poured into the upper reservoir flows into the flask to displace the air. The glass tube leading from the reservoir should extend almost to the bottom of the flask.

Place the magnesium silicide in the flask, replace the stopper, tighten the screw



Beads of glass are easily produced in the home laboratory. Note the crucible holder



A HINT ON DRYING MOIST TEST PAPERS

Test papers can be dried quickly with the aid of a flask containing boiling water. The paper is affixed to a wire wound around the neck of the flask

clamp over the rubber section of the outlet tube, and finally fill the system with water. Ten or fifteen cubic centimeters (about a half fluid ounce) of hydrochloric acid then should be added by pouring it into the reservoir. Because of its weight, it will sink to the bottom of the flask where it will soon come in contact with the magnesium silicide.

In the reaction that follows, bubbles of silicon hydride gas will be given off. However, being prevented from escaping by the pinchcock, the gas will collect in the flask, gradually pushing the water and acid back into the reservoir.

When a quantity of the gas has collected, loosen the screw clamp. As the gas reaches the outer atmosphere it will burst into flame and burn with a bright yellow light. Take particular notice of the smoke that is formed. It contains small particles of silicon dioxide or sand formed by the reaction.

The property of silicon hydride to ignite spontaneously will be illustrated further when the apparatus is taken apart. As each small gas bubble trapped in the tubing and bottle comes in contact with the air it will explode with a harmless crackling and popping.

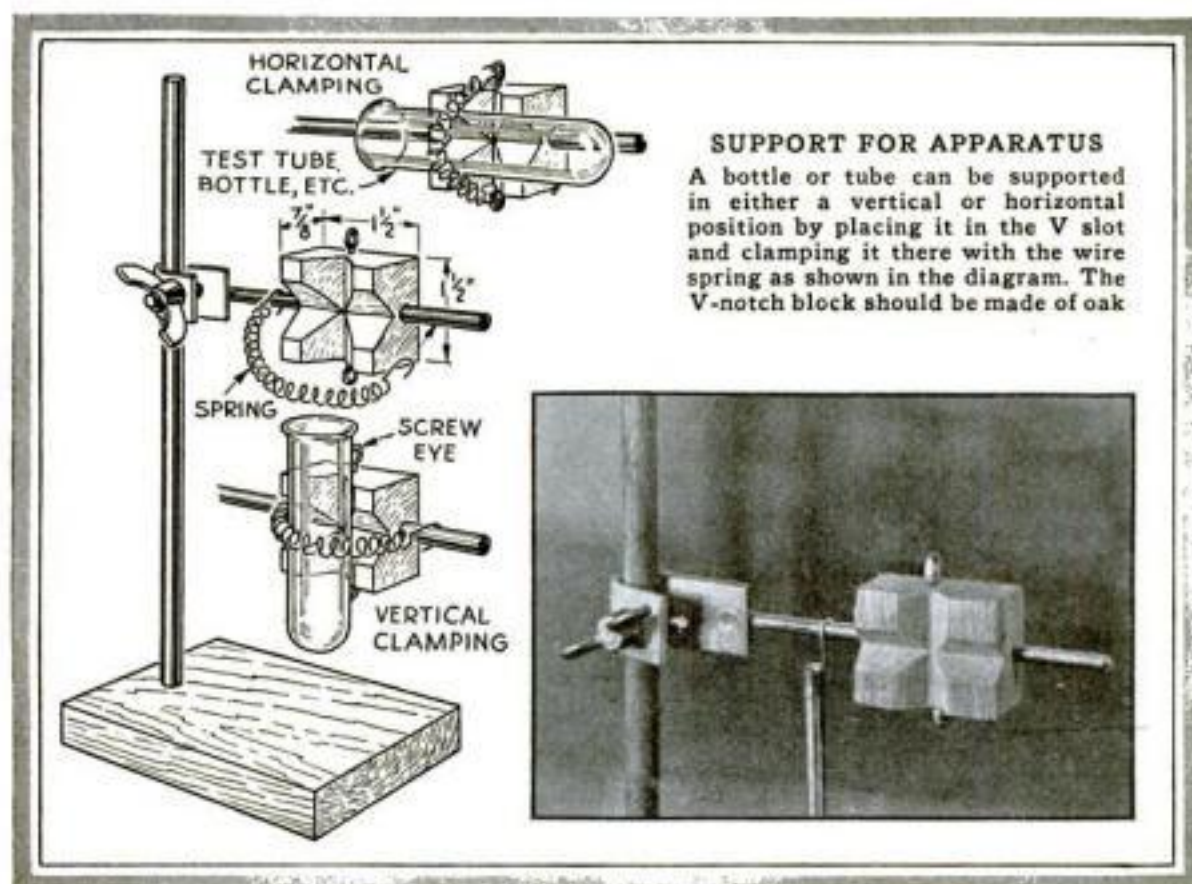
Like many elements in the chemical family, silicon has a brother. It is called boron. Ordinary household borax and boric (boric) acid both contain boron and it is with these two inexpensive and easily obtained substances that the home chemist can perform many interesting experiments.

Boric acid is a weak acid and because of its mild antiseptic properties is widely used as an eye wash. When heated, solid boric acid froths as its water of crystallization is driven off, finally melting into a crystal glasslike substance. This glass is boron trioxide and is chemically akin to ordinary sand. Like sand, it will be reduced when ignited with powered magnesium, giving free boron. In demonstrating this reaction, however, it will be best to use commercial boron trioxide, since the homemade product may contain impurities.

Boric-acid crystals can be made in the home laboratory from ordinary household borax. First dissolve a small quantity of borax in water. When tested with litmus, this solution will display an alkaline characteristic by turning red litmus blue. Then add just enough hydrochloric acid to redden a strip of blue litmus dipped in the liquid. This will convert the borax into boric acid.

To obtain the boric acid in crystal form, heat the solution to concentrate it. The boric acid crystals which separate out from the liquid when it cools can be identified by the fact that they will feel greasy to the touch. Finally, dry the crystal by placing them on a sheet of blotting paper.

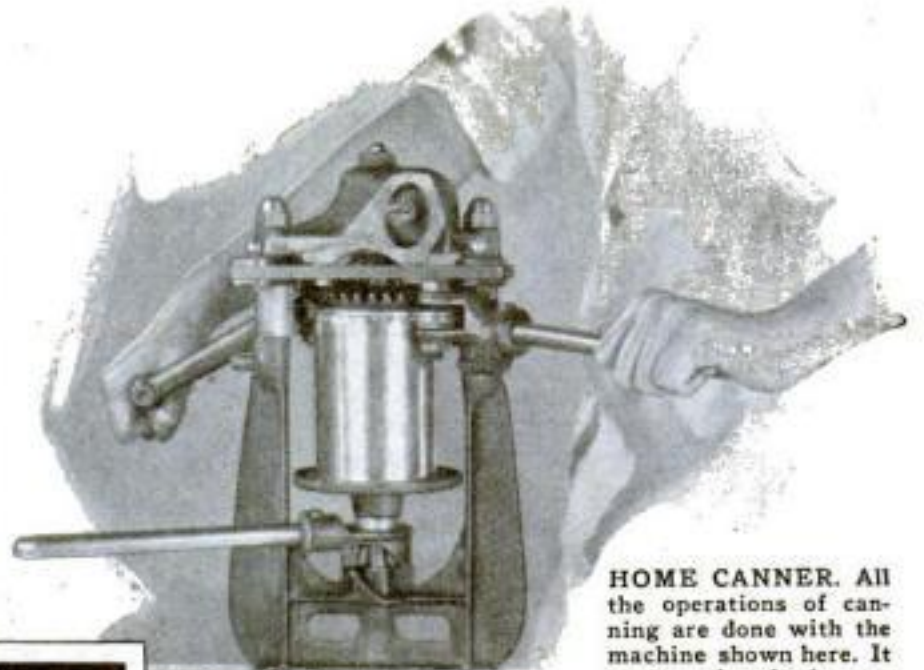
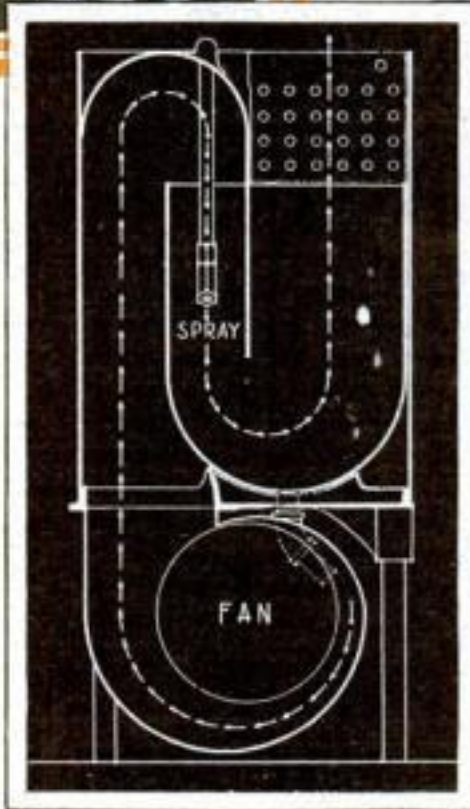
By making up simple test papers, the amateur can test any solution for the presence of boric compounds. These test papers are made by immersing strips of blotting or other *(Continued on page 113)*



New Devices FOR THE Household



NEW AIR CONDITIONER. No larger than a radiator, the air conditioner shown above, is designed for the home and will be marketed at a price anyone can afford. Chilled water from a small refrigerating unit is used to cool the air. Steam warms it. Diagram, right, explains the system



HOME CANNER. All the operations of canning are done with the machine shown here. It opens and seals tin cans



PACKAGE HANDLE. A number of packages can be carried easily with this handle. Snaps clip to the strings



WINDOW LOCK
Consisting of a rod and slide, this attachment permits a window to be opened and then locked. In this position it cannot be forced higher up



PORTABLE SHOWER
This shower outfit can be attached quickly to any faucet and is held to tile wall by rubber suction cup



SHARPENER IN SHAKER. Salt shaker shown at left contains, in its base, a knife sharpener. This addition makes the shaker handy for campers

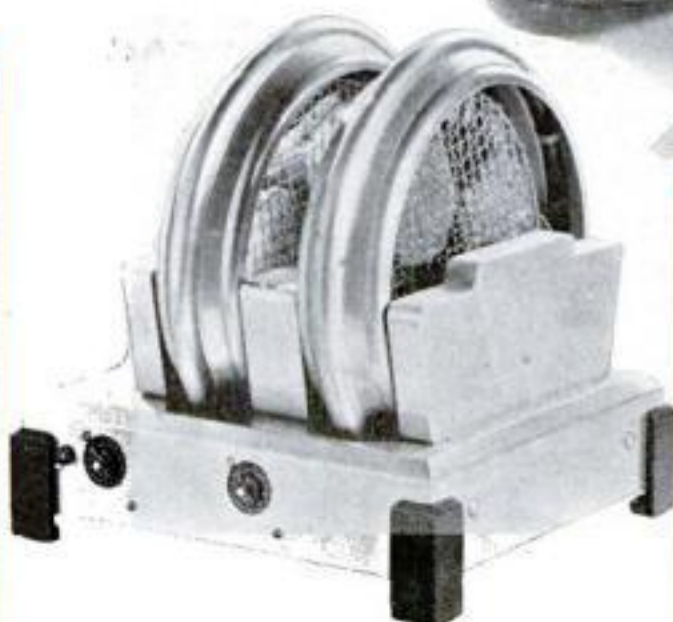


MIXER SHELLS PEAS. A pea-shelling attachment on this electric mixer is said to make it twice as fast as shelling by hand. Fresh peas are placed in the sheller and instantly empty hulls drop out one side and shelled peas on the other. Big or little pods are handled

NEW BROILING METHOD
No pans need be cleaned after food has been broiled by the method illustrated at right and below. Before broiling, the food is sealed in envelopes of a special tissue. These prevent escape of odors



CELLOPHANE STRAWS. Straws for use with soft drinks are now made of cellophane. They are said to be practically indestructible and will not collapse under the effect of either hot or cold liquids. Their transparency is a novel feature not found in other straws generally in use



ELECTRIC BROILER TURNS FOOD. Placed in the electric broiler shown above, food is rotated automatically on a revolving drum between two heating elements. Meats are thus basted as they pass through basting cups at the bottom, so a delicious flavor is imparted, says the maker



C L A M P
HOLDS BED-
CLOTHES. Attached to the foot of any bed, the clamp, above, hold clothes snugly in place. The clamp locks itself by a snap-spring action and

holds bedding firmly without injuring it until grip is released by turning the handle, as is seen in the circle above. The device has no sharp corners to catch and tear the clothes



SUCTION-CUP
HANDLE. By means of this suction-cup handle, a plate is turned into a sandwich tray. It is attached or detached in an instant and will not slip

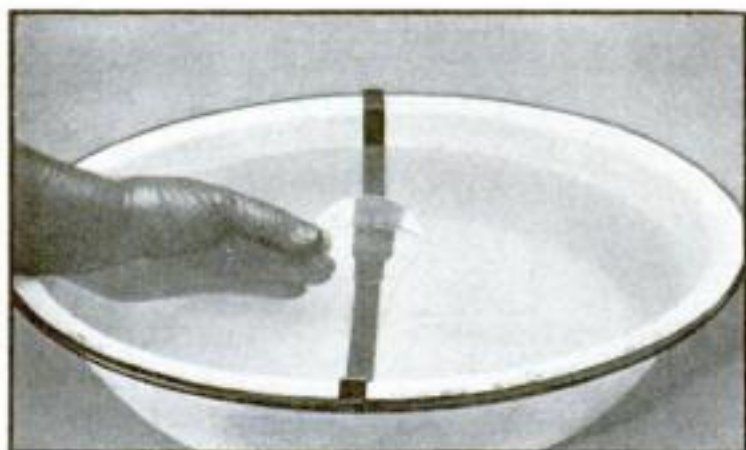


MOTOR RUNS FREEZER. Three pints of ice cream are frozen in this motor-driven freezer which, after filling, is placed in the ice-cube compartment of an automatic refrigerator. When switch is turned, the freezer does the rest quickly



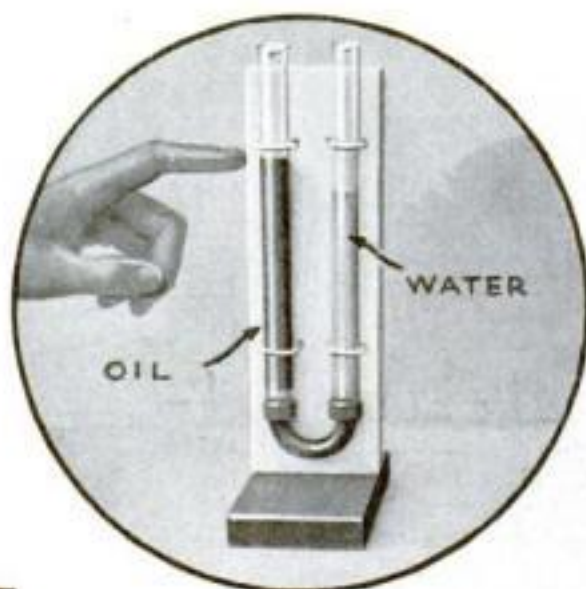
KEEPS PERCOLATOR FROM TIP-
PING. Clipping the small counter-balance, seen at left, to the nose of a percolator, keeps it from tipping over when the heavy top is turned back. Weights are provided for pots of all sizes

Home Tests to Prove Scientific Laws

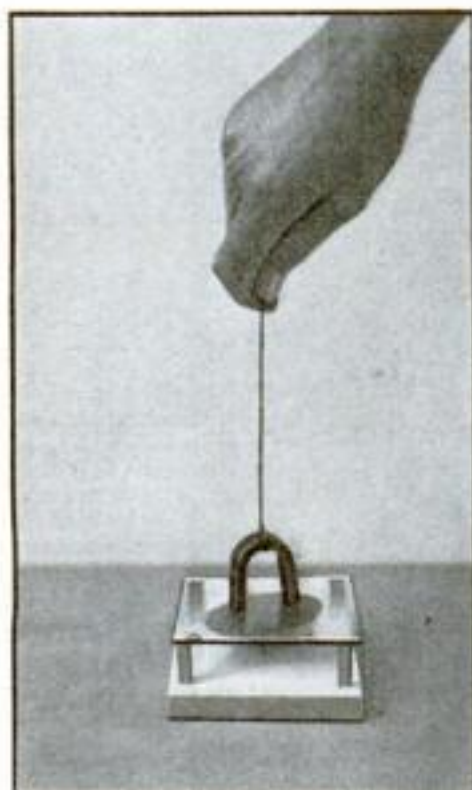


LENS DOESN'T MAGNIFY

A pan, having a black strip along its bottom, is partly filled with water. Then place a lens, as is shown in the illustration, so that about half of it is in the water and half out, holding it so it magnifies the black strip. The part out of water will enlarge the line about two times. The part that is in contact with the water magnifies the line somewhat less and the part that is completely immersed magnifies hardly at all. In water the magnification is destroyed because the refracting power of water about equals glass.

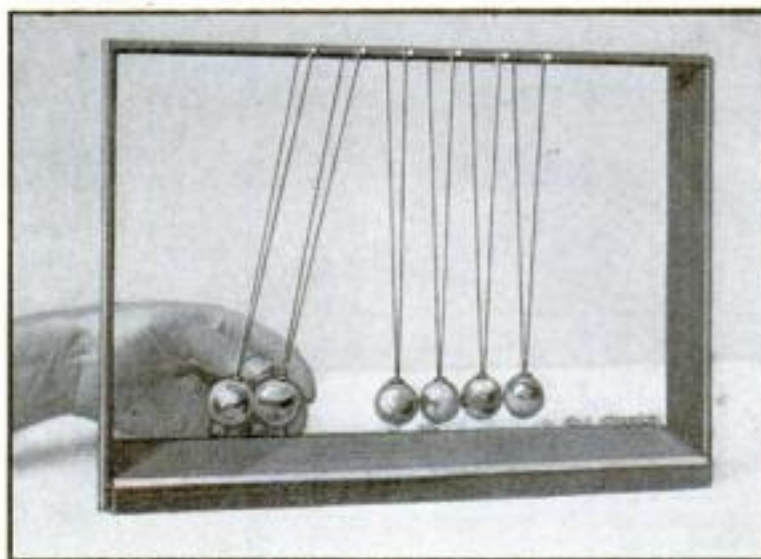


DENSITY OF LIQUIDS. This experiment with two liquids and a U-tube shows that liquids of unequal density will not seek the same level. In one arm of the tube, water is placed and in the other oil. As the oil is less dense than the water, it will stand at a higher level, being raised to a point at which its weight is equal to the weight of the column of water.



MAGNET ATTRACTS COPPER

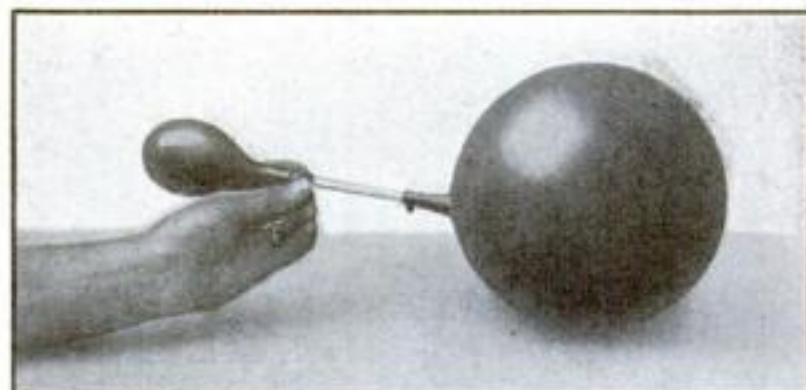
Hold a horseshoe magnet above a copper disk, as shown above, and set it spinning rapidly. If the disk is mounted so it can move readily, it will soon begin to revolve in the same direction as the magnet. This would indicate that the magnet is attracting copper. What really happens is that the magnet sets up small eddy currents in the copper. These currents produce their own small magnetic fields, which, of course, are attracted by the rotating magnet and move the disk.



REACTION EQUALS ACTION. Suspend a number of large marbles from threads in the manner shown below, using a drop of sealing wax to attach the ends of the threads. Draw one or more of the marbles to one side and let them swing back against the others. A number of marbles, equal to those you let swing will fly off the other end. This proves that reaction equals action.



MOMENT OF INERTIA. Sit on a piano stool with a fair-sized weight in each hand, as seen above. Ask some one to start you whirling and then draw the weights toward your body. Your speed will at once increase. As you extend your arms, your revolving motion will slow down. The change in speed was due to the fact that you changed the "moment of inertia." In plain words this means that weights near the center of rotation can be set turning more easily than those at a distance from the center.



MORE AIR IN BALLOON, LESS PRESSURE. With the apparatus above you can demonstrate that the more air a balloon contains, the lower the pressure. With two balloons connected by a glass tube, let one be inflated more than the other. Air from the less-inflated balloon will rush into the other, due to the fact that the small balloon has less volume to press against in proportion to the area of stretched surface.

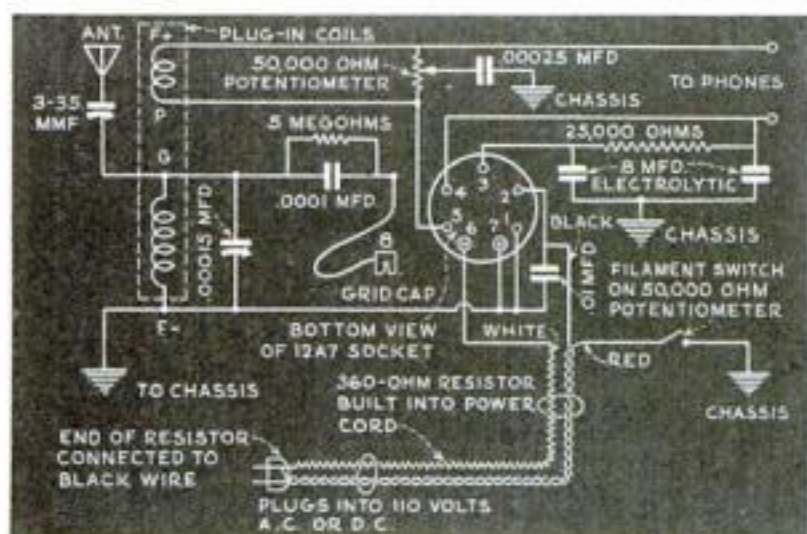


MAKING A MAGNET. Hold a steel rod as illustrated above, with the lower end pointing toward the north, and strike it several sharp blows with a hammer. Test it with a pocket compass and you will find it magnetized. The rod was magnetized because it was in line with the earth's magnetic field.

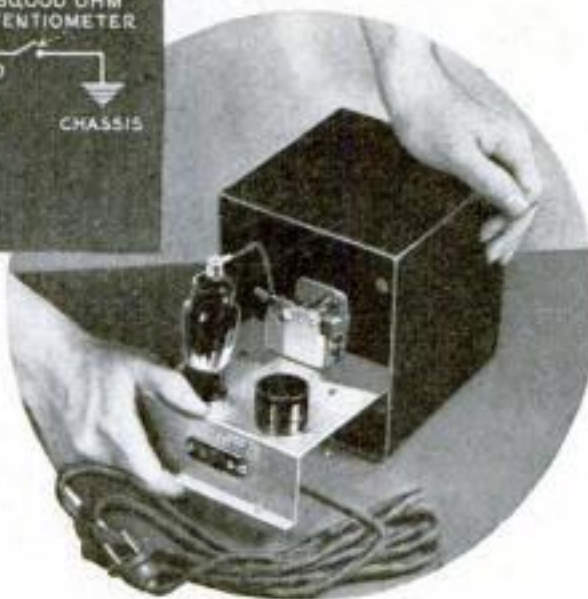
WORLD'S SIMPLEST All-Electric Set

*Easily Built One-Tube Outfit Costs Less
Than \$13 for Its Parts, Including Cabinet*

By
JOHN CARR



Upper left, at work on the mid-gut all-electric receiver that consists of only one tube and fourteen other main parts. It can be assembled in a few hours. Left, circuit diagram showing connections to the tube socket. Note that no ground is used



View of crackle-finish cabinet that was used to house the receiver. This can be omitted

HERE is the world's simplest all-electric radio circuit. Although it uses only one tube, this four-pound receiver operates without hum on alternating as well as direct current. Once assembled, it can be plugged into any 110-volt lighting socket to bring you short-wave thrills as well as broadcast programs. Yet with all its features, it is easy to build and the cost of its parts is less than \$13 including the cabinet.

The secret of the hook-up lies in its single tube—a 12A7 which serves as a

combined rectifier and detector. Like similar multi-purpose tubes, it is in reality two units in one, consisting of a screen-grid pentode and a three-element rectifier fed by a single filament.

Fundamentally, the circuit is a simple form of regenerative detector employing plug-in coils and a variable-resistance regeneration control placed across the tickler winding. Any commercial brand of plug-in coils designed for use with a .00015-mfd. tuning condenser can be used.

For those who may wish to experiment with home-made coils wound on 1 3/8-inch diameter four-prong tube bases, the specifications are as follows:

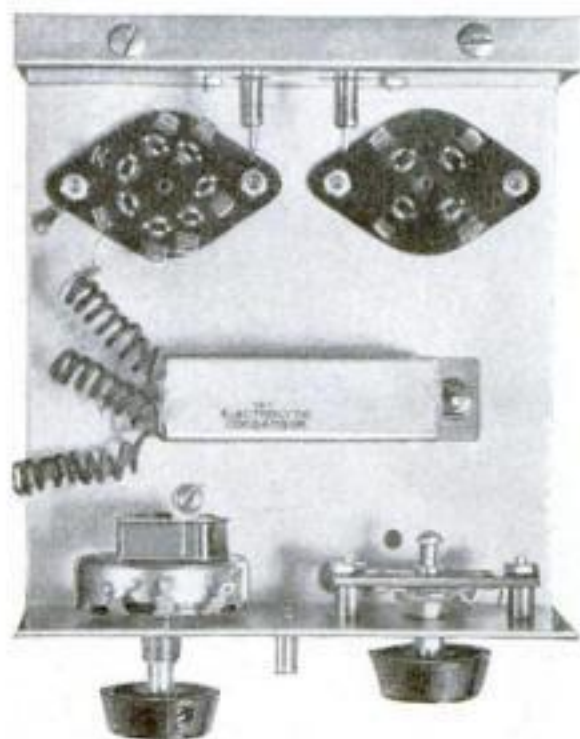
Twenty-meter coil; 4 3/4-turn tickler (+ F and P) spaced 1/16 inch from a 3 3/4-turn grid winding (—F and G), both are No. 22 enameled wire close wound. Forty-meter coil; 6 3/4-turn tickler spaced 1/16 inch from a 6 3/4-turn grid winding, both are No. 22 enameled wire close wound. Eighty-meter coil; 11 3/4-turn tickler spaced 1/16 inch from a 14 3/4-turn grid winding, both are No. 22 enameled wire close wound. One hundred-

and sixty-meter coil; 14 3/4-turn tickler spaced 1/16 inch from a 41 3/4-turn grid winding, both are No. 30 enameled wire close wound. Broadcast coil; 20 3/4-turn tickler spaced 3/16 inch from a 90 3/4-turn grid winding, both are No. 34 enameled wire close wound.

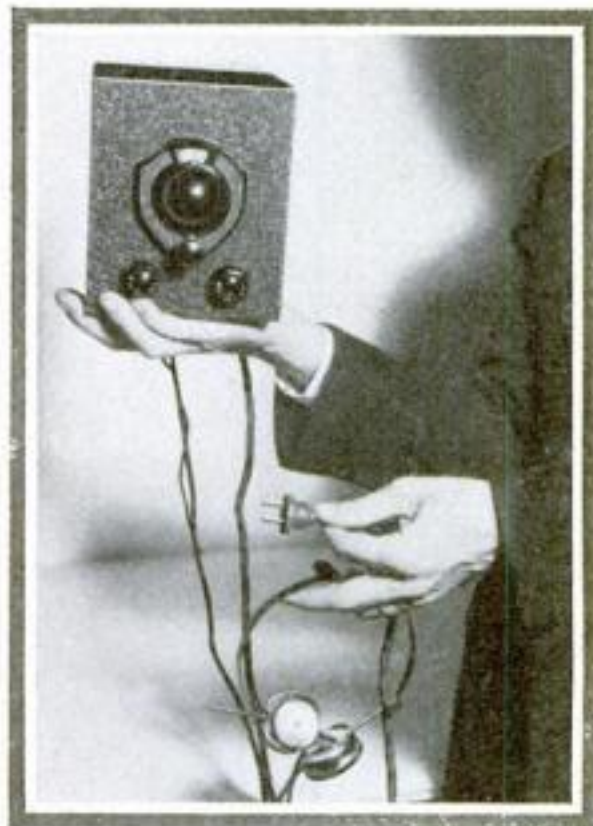
Another constructional feature of the set, an idea borrowed from the commercial A.C.-D.C. models, is its combination power cord and filament resistor. To save space, the 360-ohm filament resistor forms a part of the flexible power cable.

To control the filament circuit, a filament switch also will be required. Here again space can be saved and a control eliminated if a 50,000-ohm regenerative control, having a built-in filament switch, is used.

With one other exception, the remainder of the circuit differs only slightly from the usual one-tube short-wave hook-up. This exception is the method of mounting and controlling the 3-35-mmfd. antenna condenser. Generally condensers of this type, which consist simply of two metal plates moved together or apart by a screw, are mounted out of the way at the rear of the chassis. To adjust them, a small screw driver must be used. In the receiver shown, however, the control was simplified by mounting the condenser in back of the front face of the chassis and soldering an extension fitted with a knob to the adjusting screw. This construction is shown below at the left.



This view of the underside of the aluminum chassis shows the position of the various parts



Complete, the receiver and earphones for the all-electric set will weigh less than five pounds

Ingenious Ideas for RADIO FANS



A flexible cable controls volume and tuning mechanically

Inexpensive Remote Control

ENTIRELY mechanical in operation, the latest type of remote control (at left) is both inexpensive and easy to install. Electric motors and complicated connections are eliminated. To install it, all that is necessary is to replace the regular tuning and volume knobs with two small units fitted to the end of a fifteen-foot flexible remote-control cable. Two knobs and a dial at the control head then give finger-tip control of volume as well as tuning. Stations can be logged by means of the calibrated dial.



Lighted Test Prods

TEST prods, fitted with a handy head-light for work in the dark depths of a crowded radio set, are the latest convenience for the amateur experimenter and serviceman. The light, a small, low-drain flash-light bulb, is clamped securely to one of the prods in such a way that it can be quickly adjusted to any position. Current for the lamp is supplied by a flash-light cell housed in a small case that can be carried conveniently in the pocket.

Code Practice Outfit Has Realistic Tone

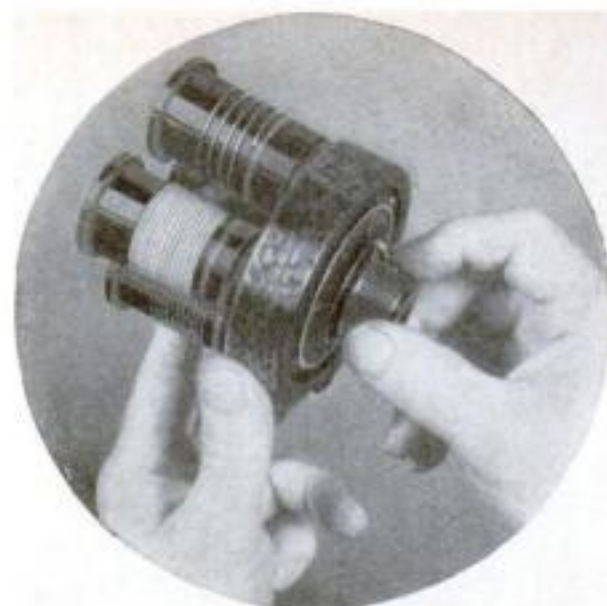
TO MAKE code practice more realistic for the beginner, a simple oscillator unit operating on four flash-light cells recently has been placed on the market. By regulating a control knob mounted on the top of its neat crackle-finish cabinet, the note can be altered to give a perfect imitation of the dots and dashes sent out by regular continuous-wave stations. Tip jacks, supplied at the front and rear of the cabinet, make it easy to connect the earphones and key into the circuit.

Coil Gives Band Spread

BAND-SPREADING features can be obtained with even the simplest short-wave receiver when a recently developed plug-in coil is used. Although wound along the usual lines, coils of this type contain an auxiliary low-loss trimmer condenser mounted at their upper ends. A convenient screw allows the condenser plates to be adjusted to spread for each coil over a larger portion of the dial of the .00014-mfd. tuning condenser used, eliminating crowding, overlapping, and interference between stations.



A condenser on this coil is adjustable to give band spreading



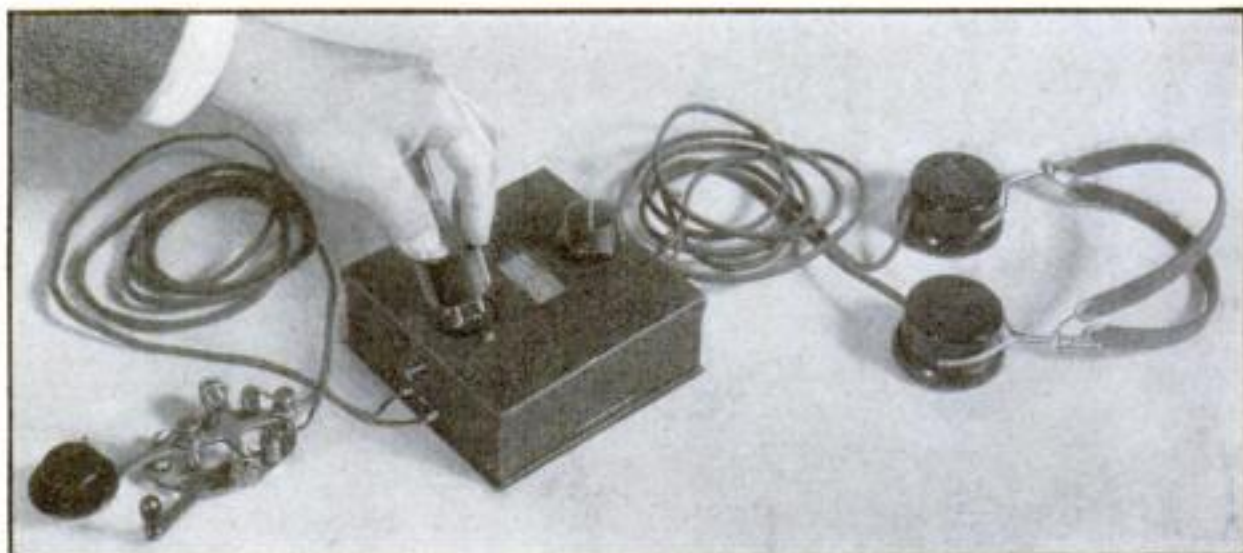
Any one of four coils can be selected instantly with this self-cleaning contact switch mounted on the receiver panel

Novel Coil Selector Eliminates Changing

BOTHERSOME changing of plug-in coils in short-wave receivers can be eliminated by making use of the coil selector shown above. A special self-cleaning contact switch, which can be mounted on the receiver panel, makes it possible to select any one of four coils with a twist of the fingers. Cleverly arranged sockets at the rear of the selector can be used for coils with four, five, or six prongs. Convenient soldering lugs at the rear of the unit make it a simple matter to wire the necessary connections into the circuit.

New Robot Receiver

EVEN small radio sets will soon be entirely automatic if the arrangement designed by a well-known radio inventor proves successful. A complete outfit, looking little different from the usual radio receiver, was demonstrated recently to a group of radio engineers. The set not only tuned itself, picking first one station and then another according to a prearranged schedule, but also turned itself on and off at desired hours. The brain of the selecting device is a modified form of electric clock mounted artistically on the front panel of the receiver. Holes around the dial of the clock receive miniature plug-in cords similar to those used on telephone switchboards. Once the cords, each representing a different station, are plugged into the clock face, the radio does the rest. Automatic radios of this type are suggested as substitutes for alarm clocks.



For code practice, this oscillator unit imitates the tone of regular continuous-wave stations

Working Aluminum

FOR PANELS AND CABINETS

By
George H. Waltz, Jr.

WITH the popularity of aluminum panels and chassis, metal working has become a common radio workshop operation. Metal cutting, bending, and drilling are now as important as soldering to the amateur who mounts his home-built sets in the modern manner.

While chassis and panels, as well as cabinets, can be bought made-to-measure, the radio worker can save time and money by buying the metal in large sheets and cutting and bending it to suit himself. It is easily worked and requires only the simplest tools. Besides, there is a certain satisfaction in making even a small home-cut panel.

No difficulty should be encountered in cutting sheet aluminum. There are a number of simple methods that can be used. If the radio worker has a home workshop equipped with a motor-driven jig saw, he can save time by using it to cut his aluminum. All that is necessary is to substitute a metal-cutting saw for the usual wood saw. Feed the metal slowly, guiding the sheet so the blade follows a cutting line previously scribed with an awl or a sharp nail mounted in a wooden handle. Although its progress will be slower, an ordinary hand jig saw can be used in the same way.

Where no jig saw is available, the aluminum can be cut by breaking it. Scribe a line on both sides of the metal where the break is desired and then go over the mark several times with a sharp knife. By cutting first on one side and then on the other, you can form two deep grooves. Finally, bend it back and forth over the sharp, square corner on the edge of the bench and it will break along the line of the cuts.

If rough edges result, place the sheet between two soft-wood boards, so that only about an eighth of an inch projects, and clamp it firmly between the jaws of a vise. A few cuts with a mill file will true off the edges.

In making a U-shaped aluminum chassis

similar to that shown in the drawings, the amateur will do well to follow certain general rules of procedure. Once the sheet has been cut to the desired rectangle, the first step is to locate the bends and the centers for the various holes. By making a scale drawing of the chassis arrangement, confusion can be eliminated and mistakes avoided. Remember, aluminum marks up easily and any guide lines scribed on its surface are there to stay.



With a jig saw, the amateur has no trouble in cutting sheet aluminum to any desired shape

The second step in chassis making is drilling. The number of holes required will depend, of course, on the number of tube sockets and other parts that are to be mounted on the chassis. Each wafer-type tube socket will require one large hole (at least one and one quarter inches in diameter) and two smaller holes for the mounting screws. In planning these holes, it will be safest to take the measurements directly from the particular socket you are using.



Aluminum is so soft that, when clamped in a vise, it can easily be bent to desired shape by hand

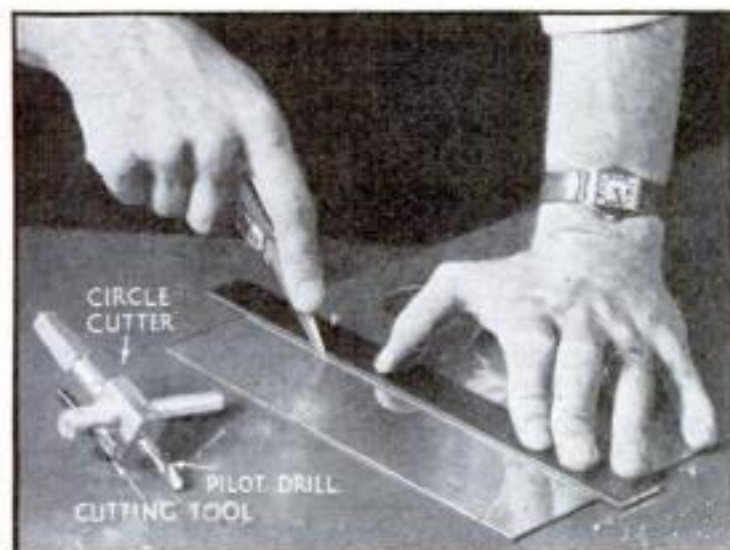
Although small holes can be drilled with ordinary twist drills, the larger holes for the tube sockets present a different problem. One of the simplest solutions is to use the inexpensive circle cutter shown in the photographs. Being adjustable, it can be used to cut holes of various sizes and its sturdy tool-steel cutter can be used almost indefinitely without regrinding. Bits of this type can be obtained to fit either an ordinary hand brace or a motor-driven drill press.

Because it is soft, aluminum tends to buckle and pull when being drilled. Also, it will clog the drill. To remedy this, feed the cutter slowly by applying an even pressure and lubricate the tool with light machine oil. If no machine oil is handy, smear a little soldering paste on the cutting point. This applies to regular drills as well as circle cutters. Mill or rat-tail files, which

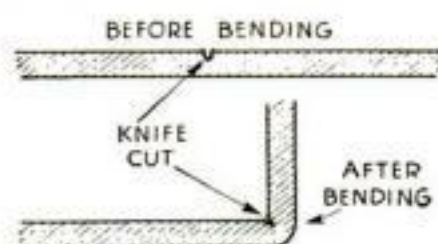
also will tend to clog when used on aluminum, can be lubricated by dipping them in turpentine.

While the commercial circle-cutting tools offer the best and quickest means of cutting large holes, the amateur can use any one of a number of other improvised methods. For instance, such holes can be cut with a jig saw if the work is fed carefully. Simply drill a small hole to admit the blade and proceed with the cutting.

Even an old pair of sturdy dividers can be used to cut holes in thin aluminum. Grind the point of one leg at an angle to form a sharp edge. The remaining leg should be left pointed to serve as a center. To use the circle-cutting divider, make a center-punch mark at the center of the circle, set the dividers to the required radius and place the pointed leg in the center hole. By applying pressure, and scribing around and around, a deep groove will be cut. Then reverse the sheet and cut the other side. Finally, the sheet will be cut through to the point where the disk of waste metal can be pushed out with



Sheet aluminum can be scored with a sharp knife for bending as is shown at right. Circle cutter is also shown





Large holes, such as those for sockets, can be drilled in sheet aluminum with the inexpensive bit shown above. It can be adjusted

the thumbs, leaving a clean-cut opening.

All holes drilled in aluminum have a tendency to be ragged and rough. However, any burr that may form can be removed easily with the blade of a sharp knife or a rat-tail file.

By placing ordinary white enamelled shoe eyelets in small holes drilled to receive connecting wires, you can give your chassis a professional touch and also protect the wires against chafing. Insert the eyelet through the hole, rest the work on a soft board, and rivet over the split end of the eyelet by hitting a punch made from a drill rod a sharp blow with hammer. If drill rod is not handy, a center-punch or a nail set can be used.

The third step in chassis making is bending. Although a special bending jig will save time, the amateur with limited equipment can do this portion of the work with a knife, a steel straightedge, an ordinary bench vise, and two hard-wood boards. First, a shallow groove should be scored with a knife on the back face of the material. This groove will prevent the metal from buckling. Then the sheet should be clamped in the vise between the two boards in such a way that the upper edges of the boards coincide with the groove. The actual bending can be done with the hands by merely pushing the metal slowly until a right angle is formed. To get a smooth corner, place a piece of soft wood over the corner while the metal is still gripped in the vise and pound it lightly with a mallet. Flanges on brackets and subpanels can be formed in this way.

IN FINISHING an aluminum chassis, panel, or cabinet, the amateur has a choice of three methods. The simplest perhaps is the lye bath recently described (P. S. M., Sept. '33, p. 57). In this process, the metal is simply immersed in a solution made by dissolving a can of ordinary household lye in a gallon of water. The resulting finish is soft and silvery.

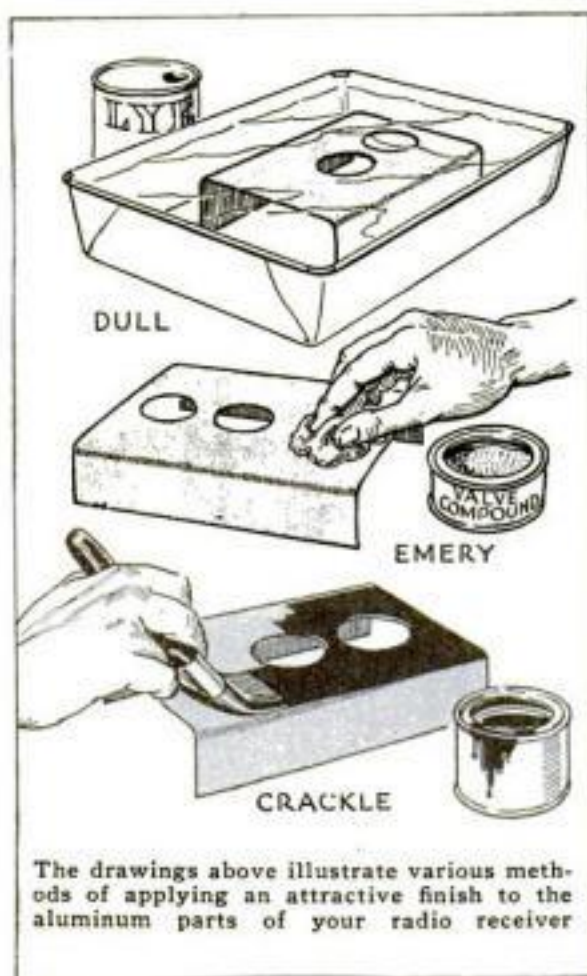
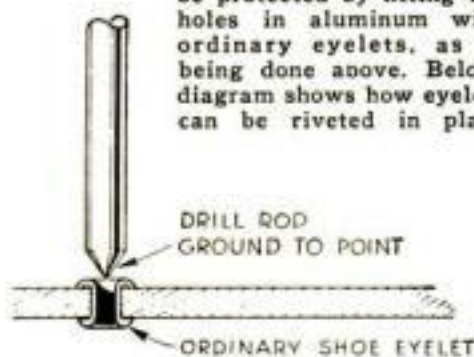
A brighter, almost crystalline, finish can be obtained by rubbing the panel with emery cloth, starting with a rough variety and working up gradually to the finest grade. Many amateurs obtain this type of finish by using valve-grinding compound in place of the emery. It is inex-

pensive, handy, and can be easily applied.

In the past year, a colored crystal or crackle type of finish has become popular on commercial receivers and transmitters. It is the same variety of finish used on cameras. The radio worker can imitate this commercial crystal effect in his home workshop by obtaining any one of a number of prepared crackle finishes. Sold in a variety of colors, they are merely brushed on the surface and drying does the rest. When finishing aluminum by this method, however, it is best to apply a ground coat of plain enamel of the same color before applying the crackle finish if you want a really good job.

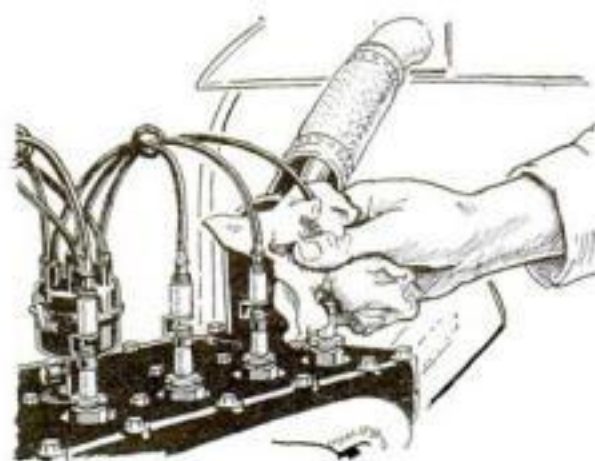


Wires through chassis can be protected by fitting the holes in aluminum with ordinary eyelets, as is being done above. Below, diagram shows how eyelets can be riveted in place

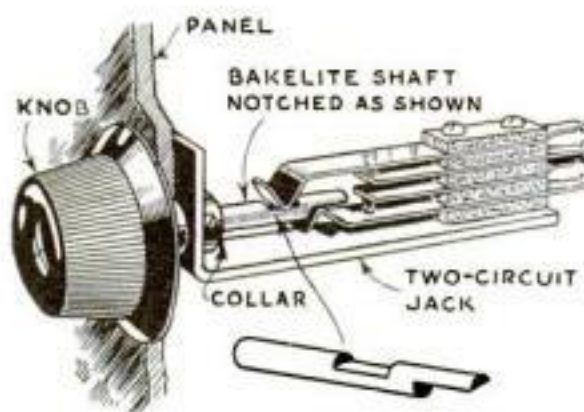


The drawings above illustrate various methods of applying an attractive finish to the aluminum parts of your radio receiver

Road Dirt Causes Auto Radio Noises



QUEER noises that develop in an automobile radio often can be traced to an accumulation of grease and road dirt. This will be so even when the ignition wiring has been protected with high-grade suppressors and condensers. In time, the wiring becomes coated with a gummy mass of grime. Containing graphite and carbon, this covering serves as a conductor for interference. The remedy is to wash wires and motor head.—E. N.



Improved Gang Switch You Can Easily Make

IN CONSTRUCTING a special receiver recently, I needed a two-gang switch. Not having one handy, I solved the problem by rigging an old two-circuit jack to fill the bill. The jack body was mounted on the panel in the usual way. Then a short hard rubber (or composition) rod having two notches in it was fitted with a regular switch knob, inserted in the hole in the jack, and held in place with a narrow collar and set screw. The notches in the rod were arranged so that in the "on" position both jack arms rested in the notches while turning the knob spread the two arms apart and opened the circuits. The same kink can be applied to any jack.—R. H.

Hears Australia On His One-Tube Set

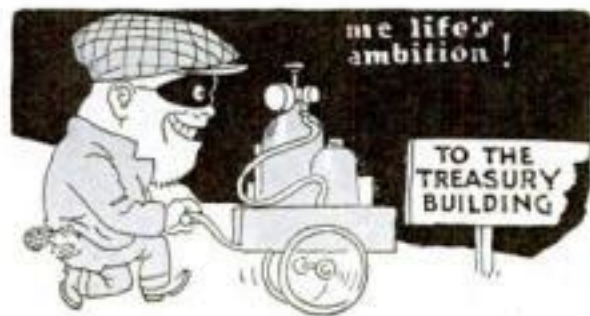
ACCORDING to a letter received recently from Wm. Raymond Anderson, a reader living in St. Charles, Ill., remarkable results can be obtained with the one-tube short-wave receiver recently described (P. S. M., June, '34, p. 64). Since he constructed the set a month ago, he has tuned in Spain, England, Germany, and Rio de Janeiro nightly, and on two occasions, has succeeded in bringing in Sydney, Australia.

Question: What causes the light given off by a firefly? W. O., Chicago, Ill.

Here's the Answer



A.—ALTHOUGH no definite source of the firefly's light has been found, it is generally believed to be caused by the rotting or oxidation of a secretion given off by cells located under the body. According to many accounts, tropical fireflies grow so large and are so luminous that they often are caged by natives and travelers and used as lanterns.



Cuts Metal Like Cheese

G. C. B., CARIBOU, ME. A flame hot enough to cut through any known metal was developed recently by Dr. Frank M. Strong. The heat producer of his supertorch is powdered aluminum which is made to burn in a blast of pure oxygen. Streams of the oxygen-loving aluminum are sprayed with oxygen into a mixing chamber where they are ignited and produce great heat.

Yes and No

Q.—DOES iron increase or decrease in weight when it rusts?—L. M., Binghamton, N. Y.

A.—THEORETICALLY, it gains in weight since the weight of the oxygen combining with it is added to that of the original metal. Actually, however, the iron rust flakes off as it forms with the net result that the iron loses in weight.

Too Old For Birthdays

Q.—How old is the sun?—J. K., Washington, N. J.

A.—ACCORDING to the best figures, the sun has enjoyed a brilliant career of no more than eight million million years.

They Reach For the High C's

Q.—IS IT true that desert and beach sands often give off mysterious singing sounds even when there is no wind?—L. Q., St. Augustine, Fla.

A.—MUSICAL sands are said to exist in many sections of the world; North America alone being credited with some seventy sing-

ing beaches. Tales often are told of the laughing sands of South Africa, the rumbling sands in Chile, and the barking sands of Hawaii. Strange as it may seem, the earth even boasts of two musical mountains. One, located in Nevada, is said to give off sounds like a tinkling bell accompanied by an organ while the other, in Chile, is known as the moaning peak.

Why Clothes Fade

R. K. P., LOS ANGELES, CALIF. Colored clothes fade because of a gradual chemical action that takes place between the oxygen of the air and the dyes. Although the sun takes the blame for fading, it is merely an accessory after the fact, simply aiding and hastening the chemical combination.

Writing on Glass

F. W. L., PHILADELPHIA, PA. An ink for writing on glass can be prepared by mixing twenty parts of shellac, 150 parts of alcohol, thirty-five parts of borax, 250 parts of water, and enough water dye to give the desired color. First dissolve the shellac in the alcohol and the borax in the water, mix the two solutions, and finally add the coloring. The mixture can be applied with a pen.

The Sun Vs. The Moon

D. A., NEW YORK, N. Y. Full moonlight has been estimated to be equal to about 1/618,000 that of sunlight. Unfortunately, however the intensity of moonlight does not increase in proportion to the bright surface visible. This is caused by the irregularity of the lunar surface and the lengthening of the mountain shadows as the light from the sun strikes the moon at a greater angle.

Nearly Empty at That

Q.—HOW complete is a so-called total vacuum?—L. G. N., Dallas, Tex.

A.—IN THE best vacuum so far created



by man, scientists estimated that the container still housed three hundred and thirty-three billionths of the original air.

Could Support Forty Tons

Q.—IF A one-inch cable was made of the best materials available, what weight could it be expected to sustain?—R. G., Glen Cove, L. I., N. Y.

A.—GOVERNMENT specifications for wire rope state that the highest safe strength for a one-inch cable made of the best uncoated plow steel is 80,000 pounds.

World's Largest Lakes

G. H. B., MILWAUKEE, WIS. Lake Superior is the world's largest fresh-water lake, having a length of 380 miles and a maximum width of 160 miles. To the 800-mile-long Caspian Sea goes the honor of being the world's largest lake, but it contains salt water.

The Gamma Rays

D. A. V., LONGMONT, CALIF. Gamma rays are the radiations from radioactive substances such as radium. They are similar to X-rays only of shorter wave length. Gamma rays are particularly penetrating, being capable of passing through thick layers of metal.

The A B C of Vitamins

S. B., OKLAHOMA CITY, OKLA. Vitamins foster health and growth. Although their exact chemical nature is not known, six already have been discovered and identified with letters of the alphabet. Vitamin A determines growth and body weight. Vitamin B prevents nervous disorders and stimulates the appetite. A diet lacking in vitamin C, on the other hand, may cause scurvy while a lack of vitamin D, sometime referred to as the sunshine vitamin, causes a bone disease known as rickets. Vitamin E has been found to be closely associated with human reproductive processes and vitamin G in a diet prevents pellagra.

Even the Mercury Freezes

Q.—WHERE is the coldest inhabited spot on the earth?—L. P., Kingston, Ontario, Can.

A.—IN THE small town of Verkhoyansk in north-eastern Siberia, temperatures as low

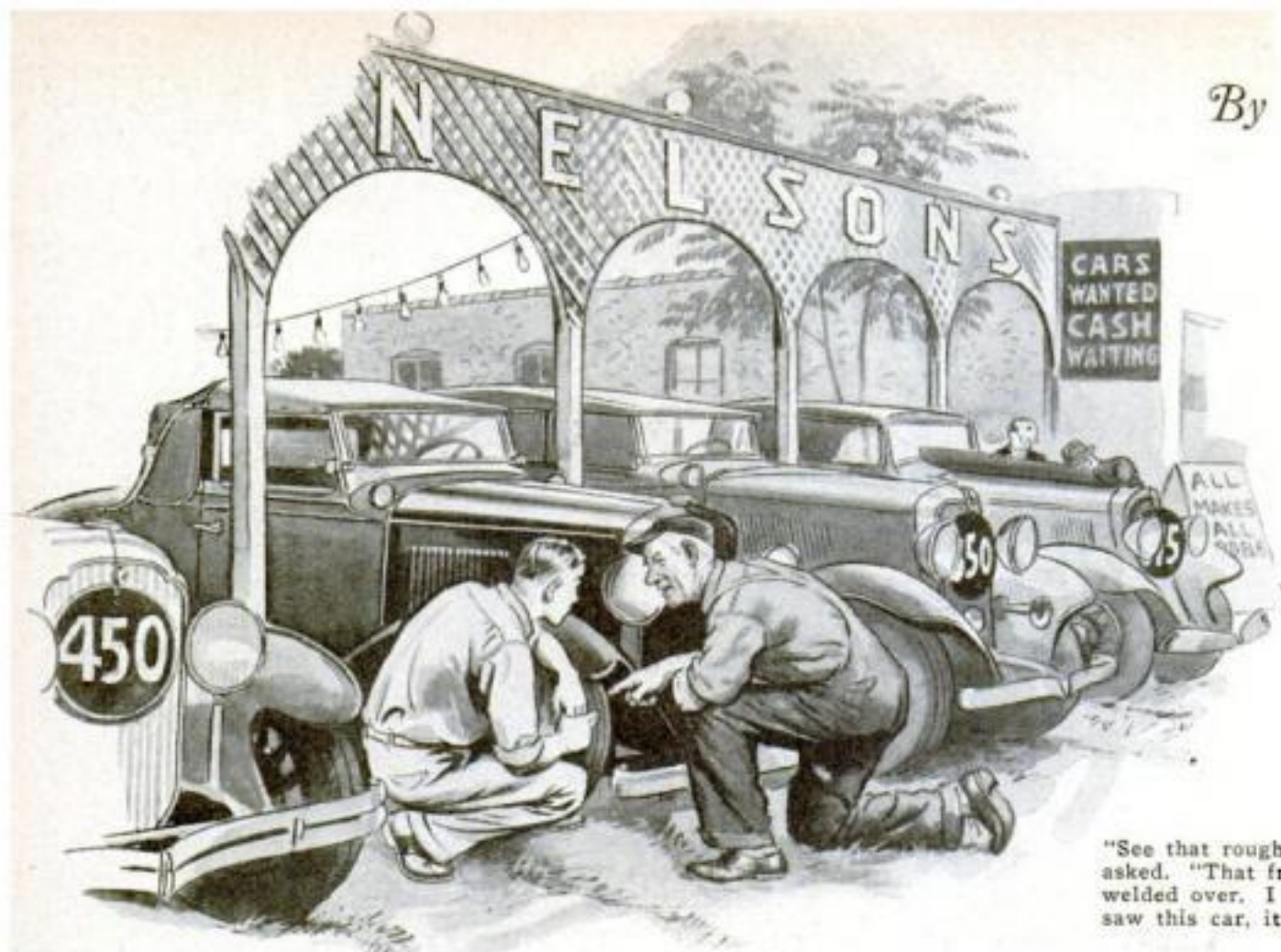


as ninety-five degrees below zero have been recorded while the average winter temperature is fifty-five below. Even the trees freeze so solidly that an expert woodsman wielding a sharp ax has trouble denting them.

War on Moths

M. S., NEW BRUNSWICK, N. J. Carbon tetrachloride is a liquid fumigant used chiefly in tight vaults for fumigating insect-infested furniture and clothing. Paradichlorobenzene, on the other hand, is a crystal which gives off a vapor that is toxic to insects. It can be used in closets, trunks, and boxes. A good moth repellent can be made at home by mixing two gallons of carbon tetrachloride, one-quarter gallon of gasoline, four ounces of gum camphor, and six ounces of oil cedar leaf. Mix these (Continued on page 119)

By MARTIN BUNN



"See that rough spot on the frame?" Gus asked. "That frame has been cracked and welded over. I had a hunch, when I first saw this car, it had been in a smash-up"

TRAPS TO AVOID IN Buying a Used Car

WITH the summer rush about over, Gus Wilson and Joe Clark were taking it easy in front of the Model Garage when a young man turned into the driveway and walked toward them.

"Have you any used cars for sale?" he inquired timidly.

"Sorry, son," answered Gus, shaking his head. "Why don't you try Nelson's used car place over on Highland Road?"

"I had a hunch maybe I'd do better buying from a garage, but no one seems to have any so I guess I'll have to go there after all."

Something in the boy's manner pleased Gus. He lacked the usual cocksureness that made most youngsters of college age just a little painful.

"Tell you what I'll do," suggested Gus as the boy turned to go, "I've got to be in that part of town later today. Suppose you drop back and I'll drive you over."

"Gosh, Mr. Wilson, will you?" exclaimed the boy enthusiastically. "Gee, that'll be swell. You see, I know you—everyone here does—but you don't know me. I'm Fred Blaine, maybe you know my father."

"Sure do," said Gus. "And I'm glad to know you."

A few hours later, Gus and his new friend were headed toward Highland Road in the gray-haired mechanic's car.

"How much can you spend for a car?" asked Gus.

"I can't spend more than \$250," said Fred half apologetically. "I've only been working for two years and that's all I've been able to save. But Dad says he'll stake me to the license and the insurance."

"That'll be plenty," Gus assured him. "You're buying the car at the best time of the year. The summer fad of car driving is about over and the travel bugs who bought cars in the spring want to get rid of them. Even the dealers don't want to carry a raft of used cars over the winter. But I wouldn't spend the whole \$250 on the car, if I were you," added Gus. "If you're wise you'll leave a few dollars for extras."

"Extras? What extras?" asked Fred.

"Remember, son, you're buying an old car not a new one. It isn't hard to spend at least \$25 on almost any car on the road to put it in half-way decent shape. You know batteries and tires don't last forever. Got any preference as to make?"

"I want one that won't break me," replied Fred with a grin. "So I guess that narrows it down to something small."

"Not necessarily," corrected Gus. "Sometimes a large car costs less to run than a small one. A medium-sized used car may cost you more for gas, but it's likely to be in better condition than a smaller one of the same age. Besides, even the gas isn't so much of an item. Say you drive a car 6,000 miles a year. On a small car that gives about eighteen miles to a gallon, that'll mean 333 gallons. With a larger car that only gives fourteen you'll use about 430 gallons. Figuring gas at eighteen a gallon, the larger car will only cost about \$17 more a year to run or about thirty cents a week. If a small car has been ridden hard you can spend that much in repairs."

"Never looked at it that way," Fred admitted. "But won't I get a better price on a small car?"

"Just the opposite," pointed out Gus. "Few people want a big car nowadays so small cars often bring a higher price than the larger ones."

A few moments later they were at Nelson's place and the two entered a large enclosure where more than fifty cars were neatly arranged in long rows. From the radiator cap of each fluttered a bright red price tag.

"Golly, look at this one," exclaimed Fred as he spied a trim blue touring car and poked his head under the top. "And it's only gone a little over 12,000 miles."

Gus walked around the car feeling the tires and poking his experienced hand under the chassis here and there. "Don't put too much faith in speedometers," he advised with a grunt. "It seems even some of the best dealers can't resist setting 'em back. Besides, there's a heap of other ways of telling how far a car has been driven. Take a squint at those tires, for instance."

"Why, they're not so bad," argued Fred, after a circuit of the car.

"Right," agreed Gus with a wink. "But they're all different makes and that's what tells the story. Tires that come with a car when it's new will last 20,000 to 25,000 miles if they're not abused. So when you see a car with low mileage and it has several different kinds of tires on it, look out. Either the speedometer's a liar or the car's been owned by a throttle hopper who's worn out the tires and probably the car's insides before their time."

"But look at the finish," said Fred, fondly stroking one of the fenders. "Looks almost new."

"Yeah, and *(Continued on page 118)*



USING A MICROSCOPE FOR

Polarized Light Experiments

By H. J. SEXTON and
O. M. FREEMAN

Amazing and incredibly beautiful sights await the amateur microscopist who makes polarizing equipment for his instrument

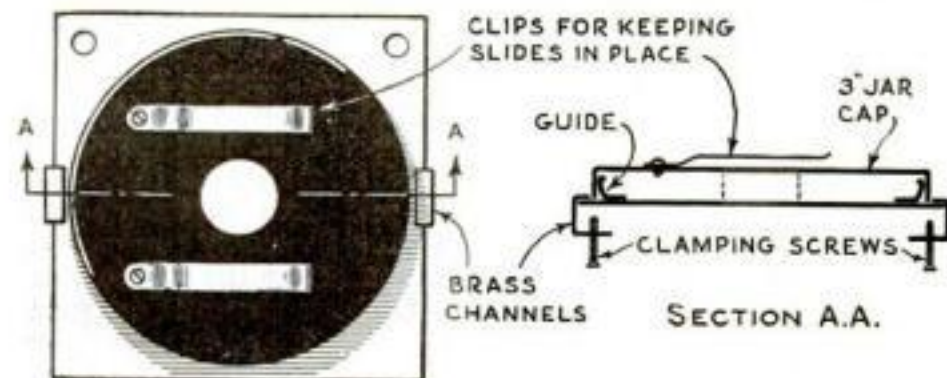
WITH apparatus costing less than two dollars to make, the amateur microscopist can now produce and observe polarized light. This opens up a field hitherto limited by the prohibitive cost of the required accessories. It enables the amateur to witness the most beautiful phenomena and conduct the most delicate investigations of which the microscope is capable.

Nowhere in nature are to be found more astonishing and magnificent displays of variegated color effects or more exact delineations than those produced by polarized light in its passage through a simple slide made from a strip of mica, or a thin section of horn or quill. No degree of magnification, however high, will so clearly resolve the limits and boundaries of a specimen composed of layers normally transparent to ordinary light.

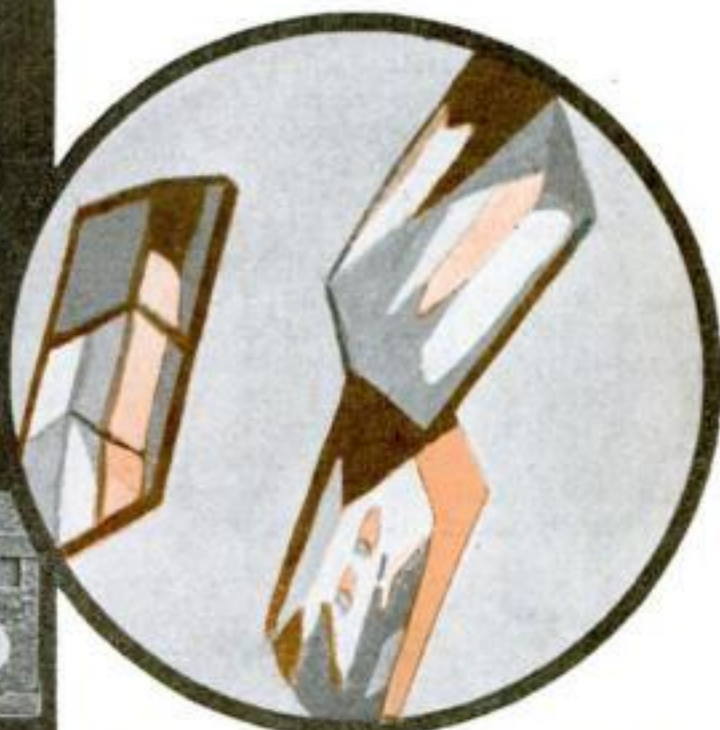
Polarized light differs from ordinary light in that the wave vibrations of the beam in all but one plane are retarded or filtered out. The amazing colors and definition visible in the specimen, through

which the light wave vibrations in the single plane pass, are produced by interference. An example of such interference in nature is presented by the color rings one sees when lubricating oil is dropped in water.

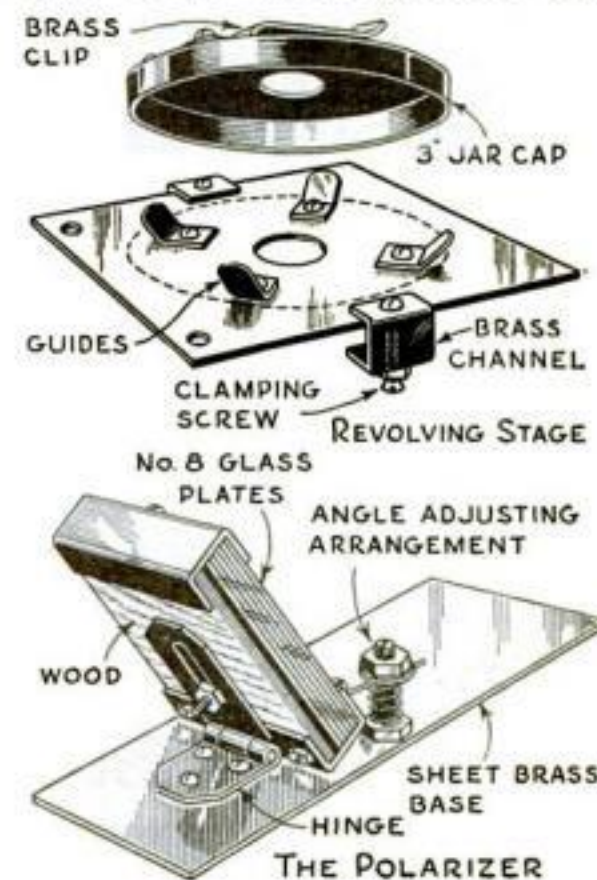
To construct the underneath part of the apparatus, the following materials are required: three glass photographic plates 9 by 12 cm., or any flat thin glass of similar quality; some thin plate and strip brass; a few small brass machine and wood screws; a short length of threaded brass rod with a nut to fit; a spiral steel

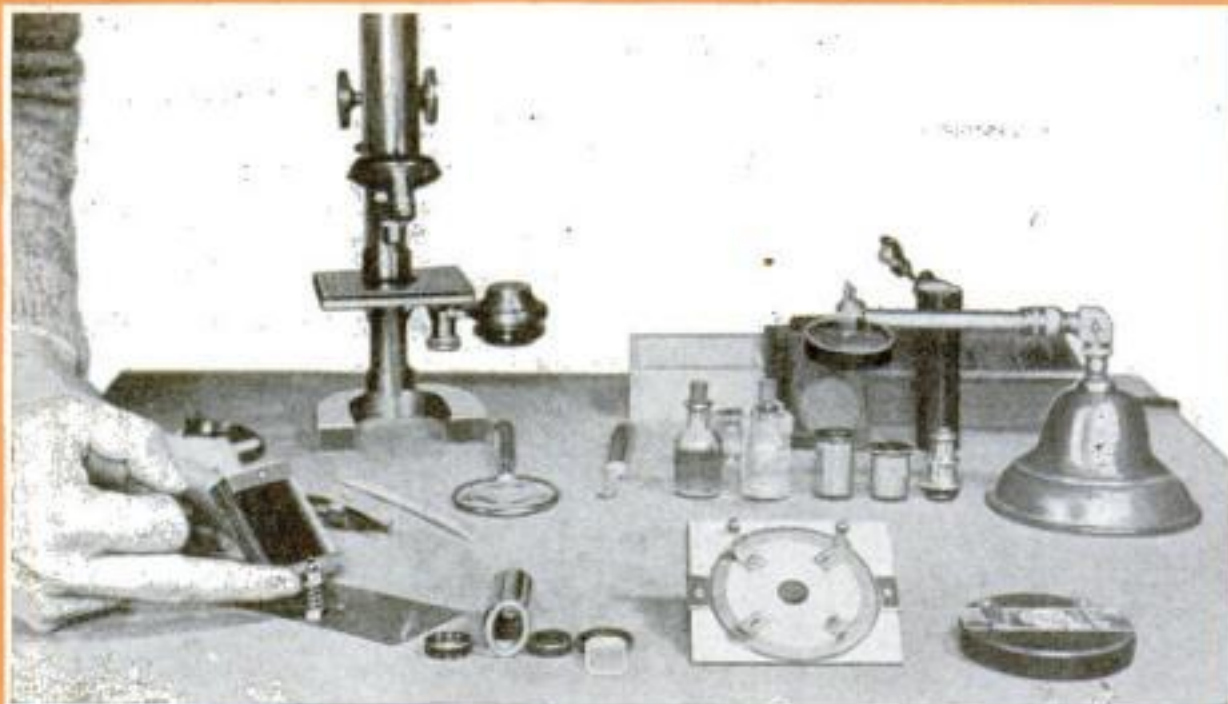


Left: Top of the revolving stage which has clips to keep a slide in place; and cross section to make clear how the jar-cap turntable is centered on the brass plate by means of four sheet metal guides. Right: Sketches of the turntable and the polarizer unit



Copper sulphate crystals by polarized light





All parts of the polarizing equipment are shown in the foreground of this view. At left is the polarizer; in the center, the analyzer with clipped-off cover glasses; at right, the stage

or brass spring to surround the threaded brass rod; a short, stiff piece of copper wire; and a small brass hinge. A little black varnish or enamel is required for painting one of the glass plates.

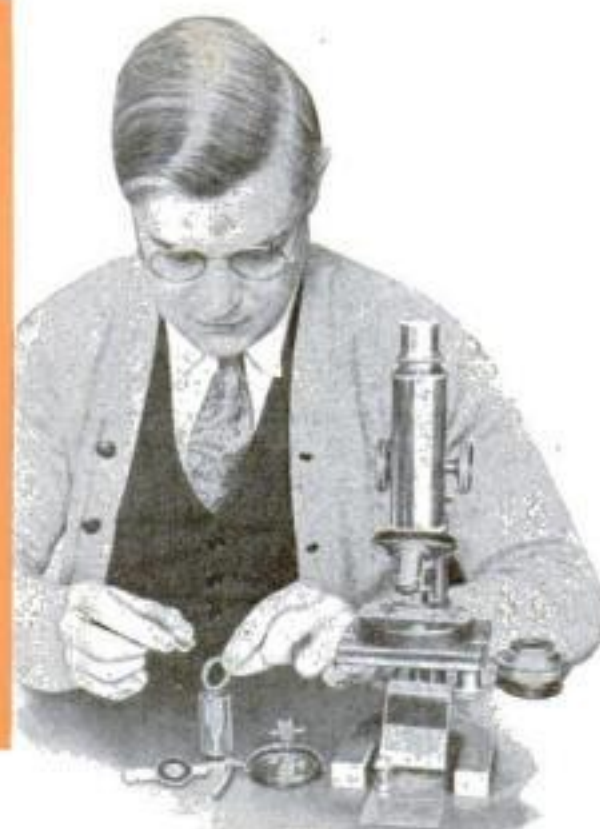
For the construction of that part of the polarizing apparatus which fits within the eyepiece, or ocular, of the microscope, from fifteen to twenty very thin (.18-in.) flat, rectangular $\frac{3}{8}$ -in. cover slides and a small piece of thin, stiff cardboard are required.

A revolving stage is also needed. This can be conveniently constructed from a 3-in. circular jar cover, some thin plate and strip brass, and a few machine screws. Two pieces of spring brass are needed for holding the slides in place.

Only ordinary ability in the use of tools is necessary, and no tools other than those usually found in the average handy-

man's kit are required to do the work.

To construct the underneath part of the apparatus or polarizer, which fits between the microscope horseshoe, the three glass photographic plates are thoroughly cleaned of all film, and each plate is cut into four rectangular plates of equal size by two lines drawn at right angles across its face with a glass cutter. One of these twelve plates is painted on one side with a thick coat of black varnish and allowed to dry. This glass plate with the black back is placed together with eight or ten of the other clean glass plates, and all are mounted together to form a mirror. This mirror is backed with a $\frac{1}{8}$ -in. thick piece of wood and then attached to a base made of the thin brass plate by means of the small brass hinge. A method of adjusting it at any desired elevation is provided by means



Rock asbestos seen by polarized light, although no reproduction can even approximate the prismatic brilliance of the many colors. Above: Inserting cover glasses into ocular

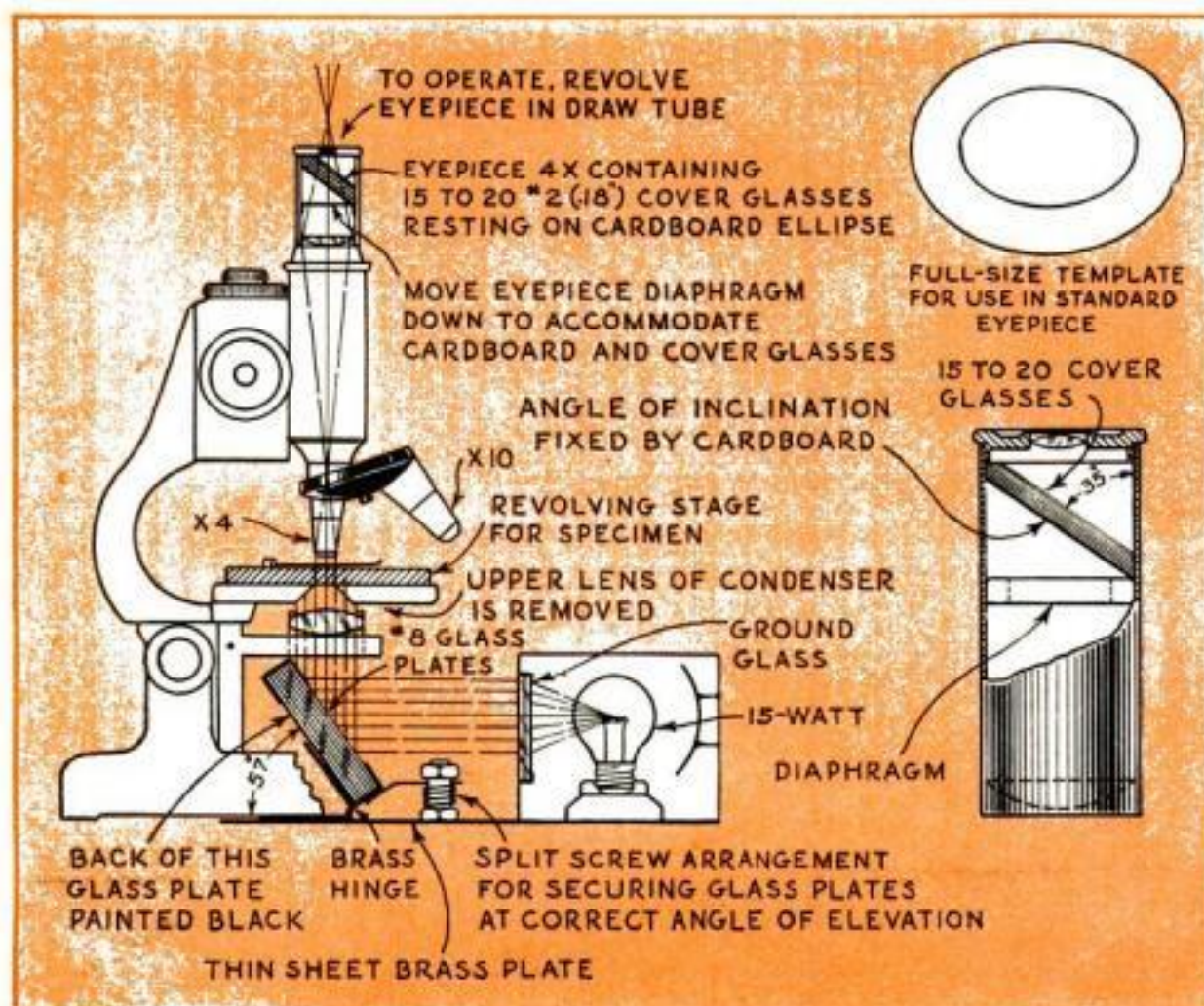


Diagram showing how the apparatus is set up for use with any standard microscope; a cut-away view of the ocular to show position of cover glasses; and a template for cutting the cardboard

of a split threaded brass rod with nut and a spiral spring as shown. Experiment seems to dictate that the angle this mirror makes with the base for best operation is somewhere between 55 and 57 deg., and varies with the number of sheets and the thickness and quality of the glass used for constructing the polarizer.

For that part of the apparatus which fits within the eyepiece, or ocular, and which may be called the analyzer, it is necessary only to cut the piece of thin cardboard to the shape of the template provided in the sketch, and then paint it with the black varnish.

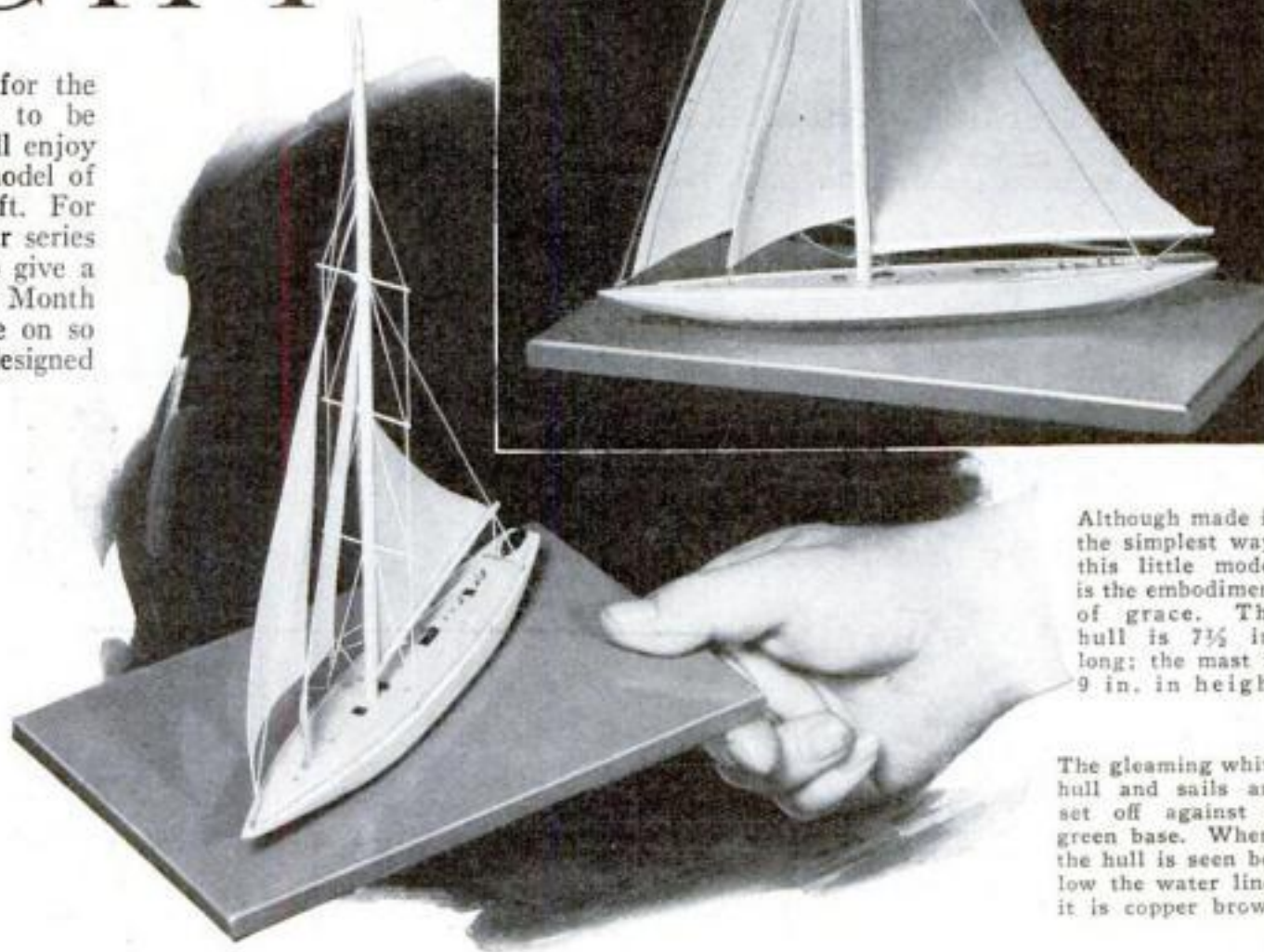
The corners of fifteen or twenty of the very thin cover slides are snipped off with side-cutter pliers. Unscrew the upper lens from a 4X eyepiece, or any eyepiece with the same or longer tube, and drop the elliptical piece of cardboard within the tube until the edge of the cardboard touches the screen which is located within the eyepiece and which will have to be pushed down to accommodate the cover slides. Now drop the snipped cover slides on top of the cardboard. The periphery of the cardboard ellipse should touch the eyepiece tube, and both cardboard and cover slides should lie snugly together in a slanting position across the tube of the eyepiece. The template shown is designed for a standard No. 4X eyepiece, but any standard eye- (Continued on page 103)

HOW TO BUILD A BEAUTIFUL WATER-LINE MODEL OF *America's Cup* YACHT

WITH the yacht races for the America's Cup about to be held, model makers will enjoy building a miniature model of one of these beautiful sailing craft. For this reason we are interrupting our series of historic United States ships to give a racing yacht as our Model of the Month No. 3. The cup yachts look alike on so small a scale, but this model was designed to represent *Rainbow*, the latest of the American yachts.

The model can be constructed simply and quickly from balsa wood, dowel sticks, split bamboo, pins, paper, and thread. A complete construction kit with full-size blueprint and enamels is available for 75 cents (see page 102).

To avoid the difficult underwater portion of the hull, the model is of the water-line type, mounted on a base block with sails bent before the wind and with a slight list to give the im-



Although made in the simplest way, this little model is the embodiment of grace. The hull is $7\frac{1}{2}$ in. long; the mast is 9 in. in height

The gleaming white hull and sails are set off against a green base. Where the hull is seen below the water line, it is copper brown

MODEL of the MONTH Number Three DESIGNED BY Theodore Gommi

pression of motion.

The hull, which is $7\frac{1}{2}$ in. long, is made of two pieces of balsa specified in the list of materials as A and B. Fasten these together temporarily with a few drops of glue placed near the center since they must be split apart later for painting. Mark the lines of the bow and stern shown in the side elevation and cut down to these lines with a sharp knife. Then mark the shape of the deck shown in the plan, and cut away excess wood to these lines. Round out the corners of the over-

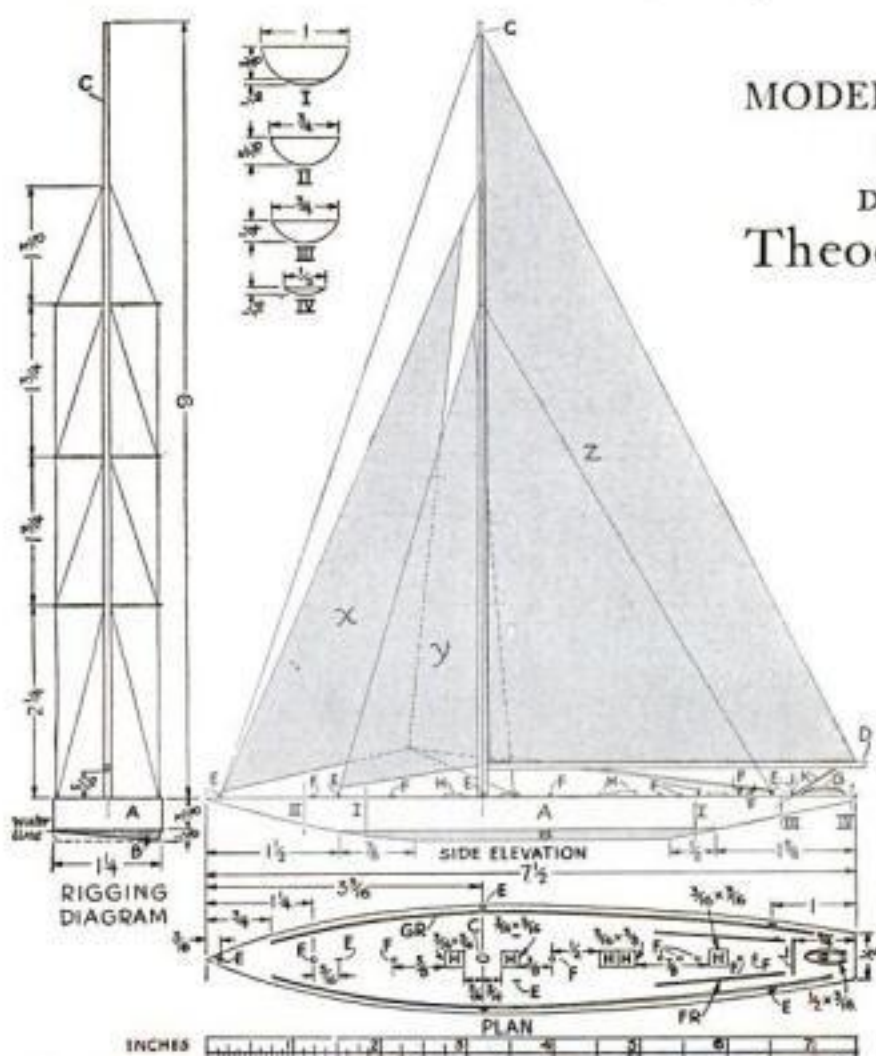
hanging bow and stern, using the cross-section diagrams as a guide. It is not necessary to make templates for so small a model, and one can rely on the eye for balanced shaping.

Although the prototype has a slight sheer, it would not be noticeable in the model, and the deck can therefore be left flat. Now get the slanting water line by sandpapering the underside of the hull until only a thin edge of B shows on one side, while the full thickness of B remains on the other. When satisfied with the shape of the hull, use very fine sandpaper on all surfaces. Attach grab rails of split bamboo (GR and FR) to the deck.

With a thin razor blade, split A and B apart. Paint the edge of B a copper brown. Paint the sides of A a glossy white and give the topside a coat of light buff to resemble the pine flooring of the deck.

Cut the hatches H and carve the boat G. These are of mahogany in the prototype and should therefore be finished with a mahogany varnish stain. If none is available, however, the same brown paint used for B can be used for these pieces. The large hatch is made of two pieces fastened to the deck and a third piece fastened to one of these.

Insert in their proper places the eight escutcheon pins (Continued on page 101)



Working drawings of the model with a scale in inches. All the parts are lettered to correspond with the list of materials



Eugene (Ore.) Craftsman Guild. W. I. King is president, C. N. Crocker, vice president, Dr. W. B. Lee, secretary

National Homeworkshop Guild will conduct greatest competition of its kind.... Awards to be made in ten separate classifications

PRIZES totaling \$2,000 in cash and ten silver trophies will be awarded in the first nation-wide contest of the National Homeworkshop Guild. In variety and general scope, it will be the greatest event of its kind ever held. For the first time it will give amateur craftsmen from coast to coast an opportunity to show what they can do in a friendly national competition based on merit alone.

The home workshop field is so immense that the contest has been split into ten divisions, with thirty-eight prizes in all. In each of the first nine divisions, the first prize will be \$100 in cash and, in addition, a silver cup or trophy; the second prize, \$65 in cash; and the third, \$35. The tenth division is a grand sweepstake prize donated by POPULAR SCIENCE MONTHLY for the club scoring the most points in all the other divisions. It will be a silver cup and \$200 in cash. The detailed list of divisions, prizes, and sponsors is given at the right.

The Guild is able to offer this remarkable array of awards because of the generous support of the nationally known manufacturers of home workshop tools, equipment, and supplies listed in the accompanying tabulation. Each company is sponsoring one division of the contest and donating the various prizes in that division. POPULAR SCIENCE MONTHLY, as the official magazine of the Guild, will bear the general expenses of administration in addition to providing the sweepstake prize.

As previously announced (P. S. M., Aug. '34, p. 74, and Sept., p. 79), the contest will be open to all clubs now affiliated with the National Homeworkshop Guild or to be organized this fall. In order not to interfere with the annual exhibitions of the local clubs, the national competition will be held late next winter, probably in March. Entries will be shipped to a centrally located city—Chicago, in all likelihood—and there judged by a committee of craftsmen and experts, a majority of whom will be chosen from outside the Guild to insure the utmost impartiality. The awards will then be announced at a national banquet of the Guild at which as many members of the affiliated clubs will be present as may find it convenient to attend. This will

Thirty-eight Prizes Now Listed in Nation-Wide Craftwork Contest

\$2,000 in CASH

1

Club Woodworking

Sponsored by

The Stanley Rule & Level Plant, New Britain, Conn.

FIRST PRIZE	Silver trophy and \$100
SECOND PRIZE	65
THIRD PRIZE	35

2

Civic Activities of Clubs

Sponsored by

Millers Falls Company, Greenfield, Mass.

FIRST PRIZE	Silver trophy and \$100
SECOND PRIZE	65
THIRD PRIZE	35

3

Furniture Made with Hand Tools

Sponsored by

E. C. Atkins and Company, Indianapolis, Ind.

FIRST PRIZE	Silver trophy and \$100
SECOND PRIZE	65
THIRD PRIZE	35

4

Furniture Made with Power-Driven Tools

Sponsored by

The Delta Manufacturing Co., Milwaukee, Wisc.

FIRST PRIZE	Silver trophy and \$100
SECOND PRIZE	65
THIRD PRIZE	35

5

Veneering and Inlaying

Sponsored by

**The Casein Manufacturing Company of America, Inc.,
New York, N. Y.**

FIRST PRIZE	Silver trophy and \$100
SECOND PRIZE	65
THIRD PRIZE	35



Wood Turning

6

Sponsored by

**Greenlee Tool Co., Division of Greenlee Bros. & Co.,
Rockford, Ill.**

FIRST PRIZE	Silver trophy and \$100
SECOND PRIZE	65
THIRD PRIZE	35

Novelties and Toys

7

Sponsored by

Henry Disston & Sons, Inc., Philadelphia, Pa.

FIRST PRIZE	Silver trophy and \$100
SECOND PRIZE	65
THIRD PRIZE	35

Model Making

8

Sponsored by

Russia Cement Company, Gloucester, Mass.

FIRST PRIZE	Silver trophy and \$100
SECOND PRIZE	65
THIRD PRIZE	35

Decorative Metal Work

9

Sponsored by

The Carborundum Company, Niagara Falls, N. Y.

FIRST PRIZE	Silver trophy and \$100
SECOND PRIZE	65
THIRD PRIZE	35

Grand Sweepstake Prize

10

Sponsored by

Popular Science Monthly, New York, N. Y.

POINT PRIZE	Silver trophy and \$200
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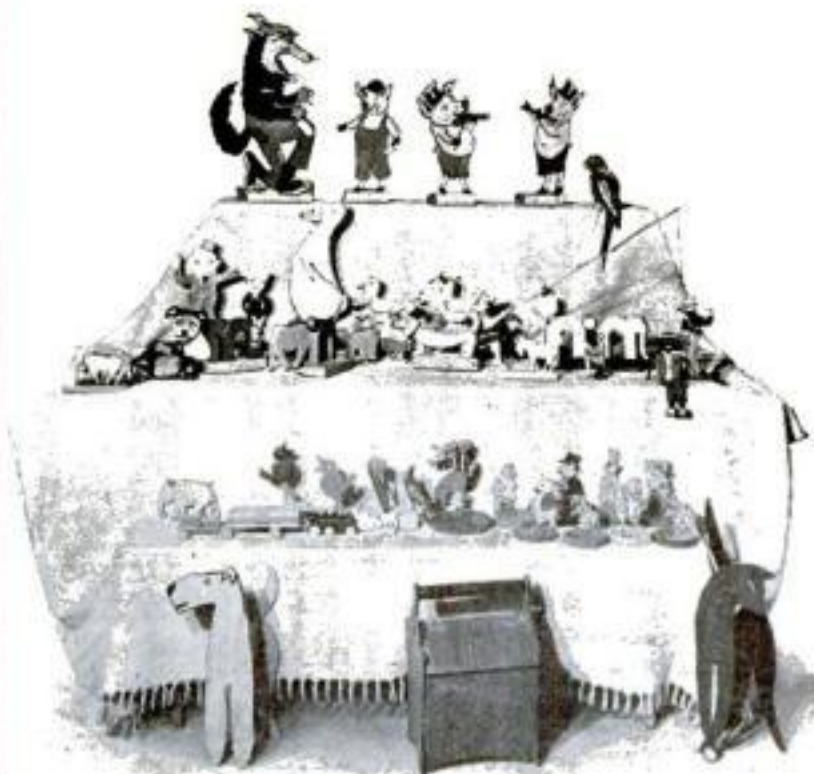
be the first great get-together of the Guild and undoubtedly the forerunner of what will become, in later years, an annual convention.

Each club, whether large or small, will have an excellent chance to win honors in the competition. That is because there are so many prizes and the classifications have been so carefully worked out.

There are really two types of prizes. One group will be awarded to the local clubs in recognition of successful club activities. The funds will go into the club treasuries and the cups will become the property of the clubs for display in their meeting rooms. The other, and larger, group of prizes will be awarded to individual members of the clubs and will become the property of the craftsmen who win them.

The club prizes are those listed in Divisions 1, 2, and 10. In Division 1, sponsored by the Stanley Rule & Level Plant, the awards will be for the best woodworking projects made by members of a club working as a unit. In other words, it can be any article constructed mainly of wood by the club as a group project. Several members may collaborate on the design, others select the materials, others do the preparatory work in getting out the stock, and still others the assembling, decorating, and finishing. The actual project may be a piece of furniture, something useful in the way of equipment for the shop, house, garage, or garden, a toy or novelty, a model, or anything the club wishes to submit provided it is essentially a woodworking problem.

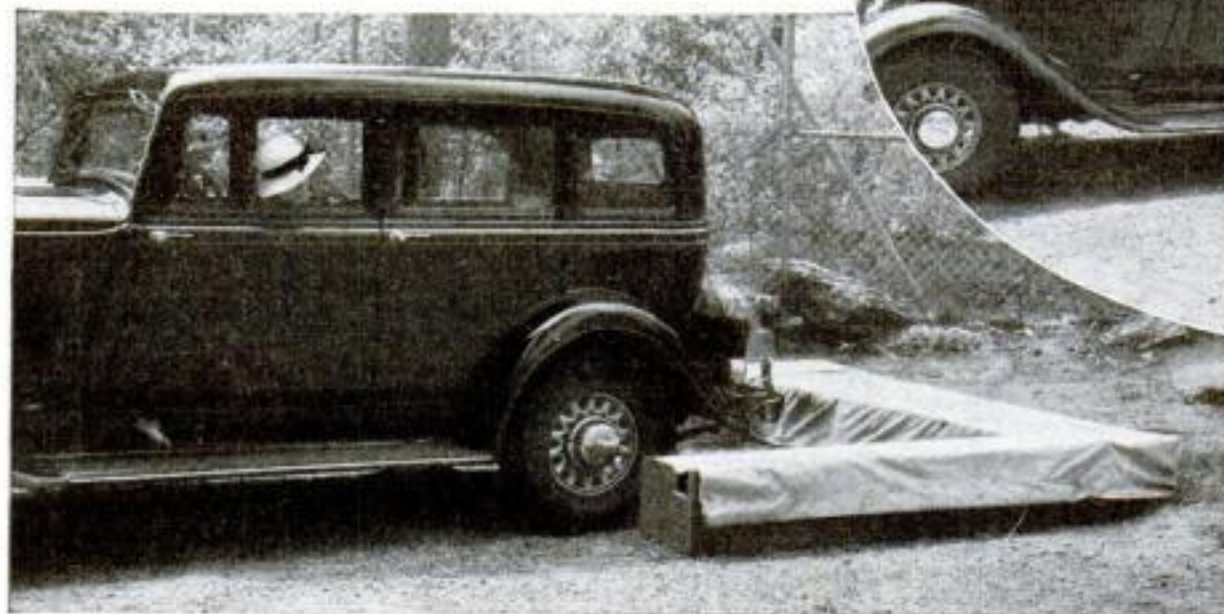
The prizes in Division 2, [\(Continued on page 94\)](#)



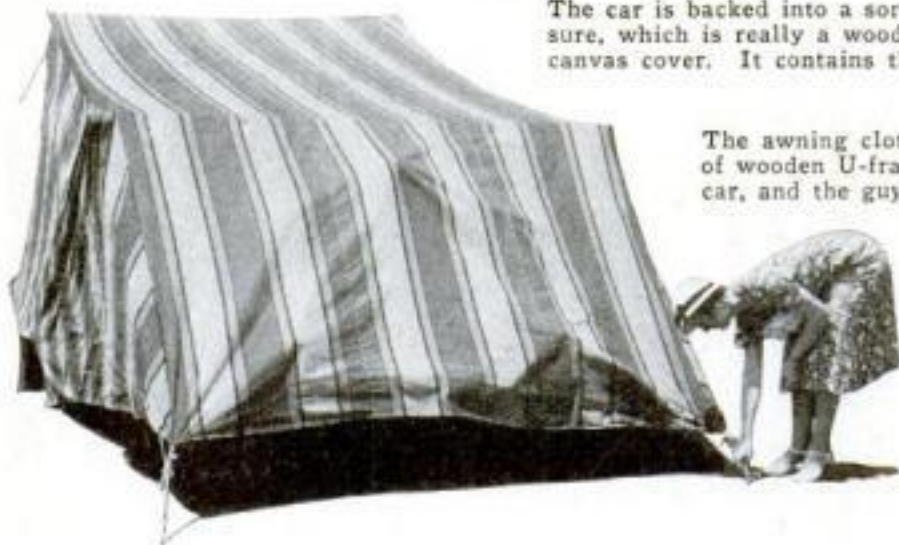
Jig-sawed novelties made by Dr. Lee, who is active in the Eugene Club. He serves as secretary and treasurer

Tent Garage

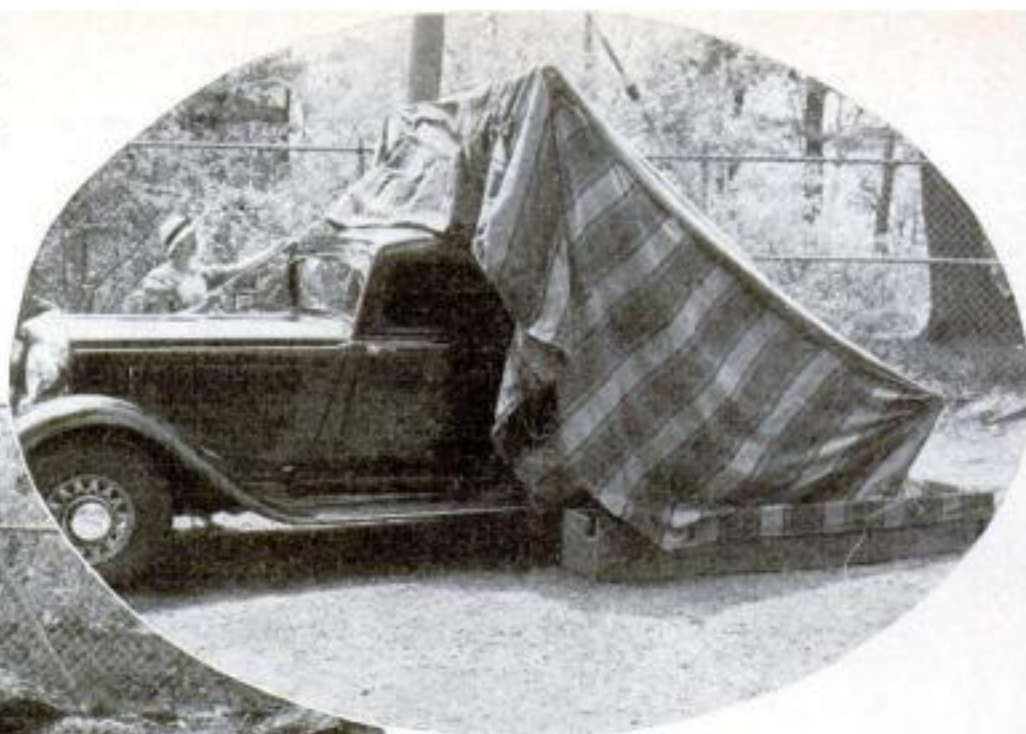
FOLDS UP
INSTANTLY



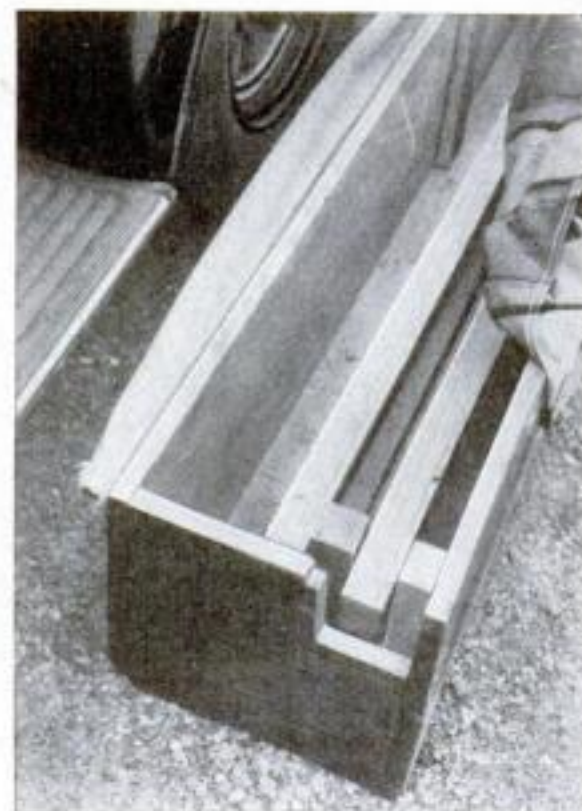
The car is backed into a sort of low U-shaped inclosure, which is really a wooden box or trough with a canvas cover. It contains the folded awning frames



The awning cloth, supported by a pair of wooden U-frames, is drawn over the car, and the guy ropes are hooked fast



The cover is raised by means of guy ropes with hardly any strain on the cloth itself



The front end of the boxes, showing how the ends of the U-frames are pivoted to stakes

IF YOU had just bought a new automobile and there was no garage available near where you lived, what would you do to protect the finish of the car?

Faced with this problem, Allen P. Smith, of New Rochelle, N. Y., found a clever solution by building a folding awning-cloth cover for his car that completely protects it from the weather. In fact, it keeps the car free from dust even better than does the ordinary home or public garage.

The design is remarkably simple and the cost is low. The awning cover has two ribs, both of which are hinged by means of stove bolts to 2 by 2 in. stakes driven deep into the ground. The ribs themselves are made of 2 by 2 in. stock reinforced at the upper joints by pieces of boards nailed across the corners. The outside dimensions of the boxlike wooden housing which protects the awning cloth when folded down are 8 by 8 ft.

As the illustrations show, the car is backed into the opening in the U-shaped box until the rear wheels strike two large rocks, which stop the car at the proper point. Then the waterproof canvas cover, which is made in three pieces, is folded over inside the U, and a pull on one of the guy ropes swings the cover up out of the box and forward over the car. Snap

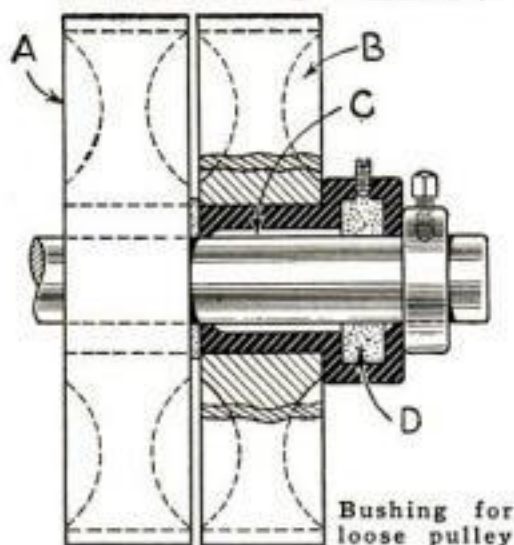
nothing that might injure the tires and make backing in more difficult.

The guy ropes extend back over the ribs and are anchored at the back so that pulling the cover in place puts no strain on the awning cloth. Stranded wire cable side guys also are attached to one rib on each side and fastened to stakes to brace the structure against heavy side winds.

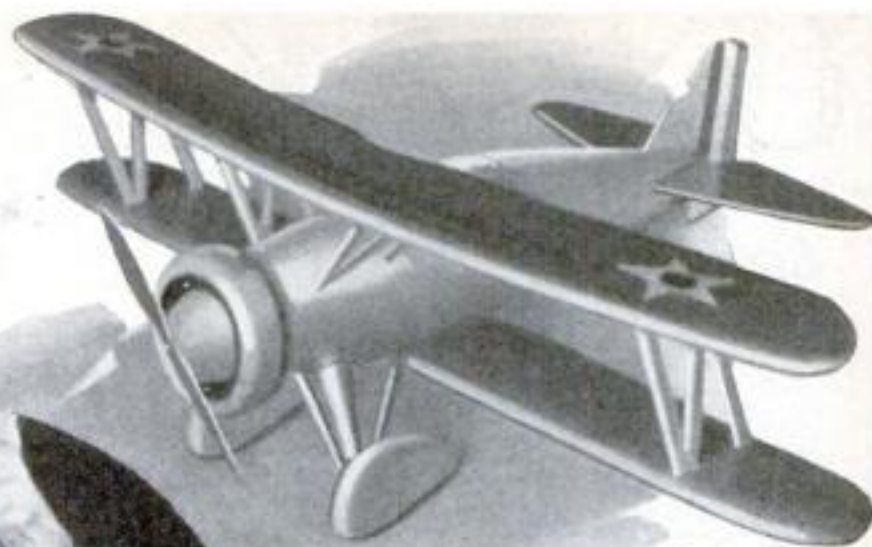
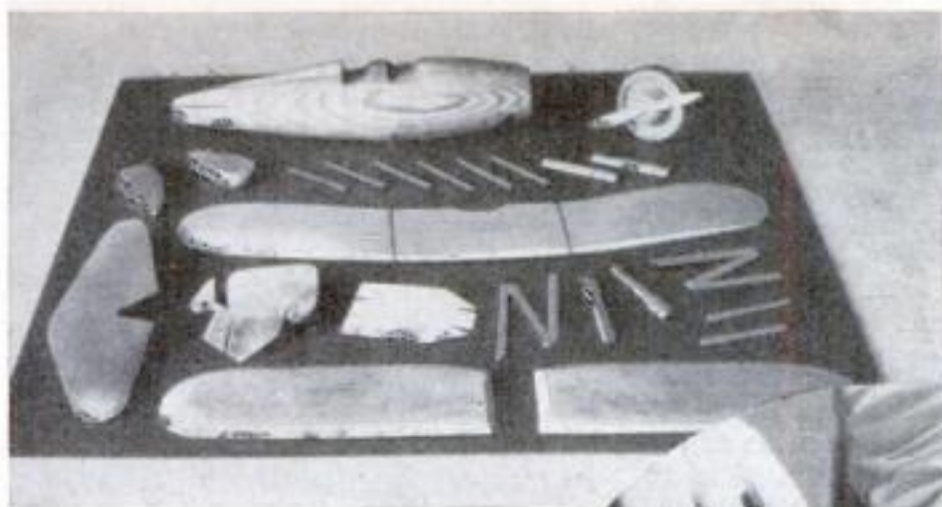
The rib that swings farthest forward is just enough smaller than the rear one so that it nests inside it when in the folded

position. When the cover is up, the rear rib stands almost vertically, and the forward one tips out over the hood of the car. Raising the cover takes but little longer than opening and closing the doors of a regular garage.—ALFRED P. LANE.

BUSHING HEAVY-DUTY LOOSE PULLEYS



Most shops have their quota of loose pulleys that have to be rebushed frequently, regardless of the type or quantity of oil used. This, of course, is due to short belts that must be kept tight. One such pulley was improved by bushing it as shown in the accompanying drawing. The tight pulley is marked A. The loose pulley B was bushed as shown, and a reservoir D was cut into the special bushing and packed with a strip of felt. Oil grooves C were cut from the reservoir to within 1/16 in. of the end of the bore. The collar is a snug fit on the shaft and held in place by a set screw. By this means a longer bearing was obtained and a good supply of oil insured. Previously this pulley had to be rebushed about every three weeks.—F. J. WILHELM.



The finished model, the few parts from which it is made, and, in oval, how the cockpit slots are finished by filing

Hell Diver

By
Donald
W. Clark

NEW SIMPLIFIED MODEL OF A FAMOUS FIGHTING PLANE

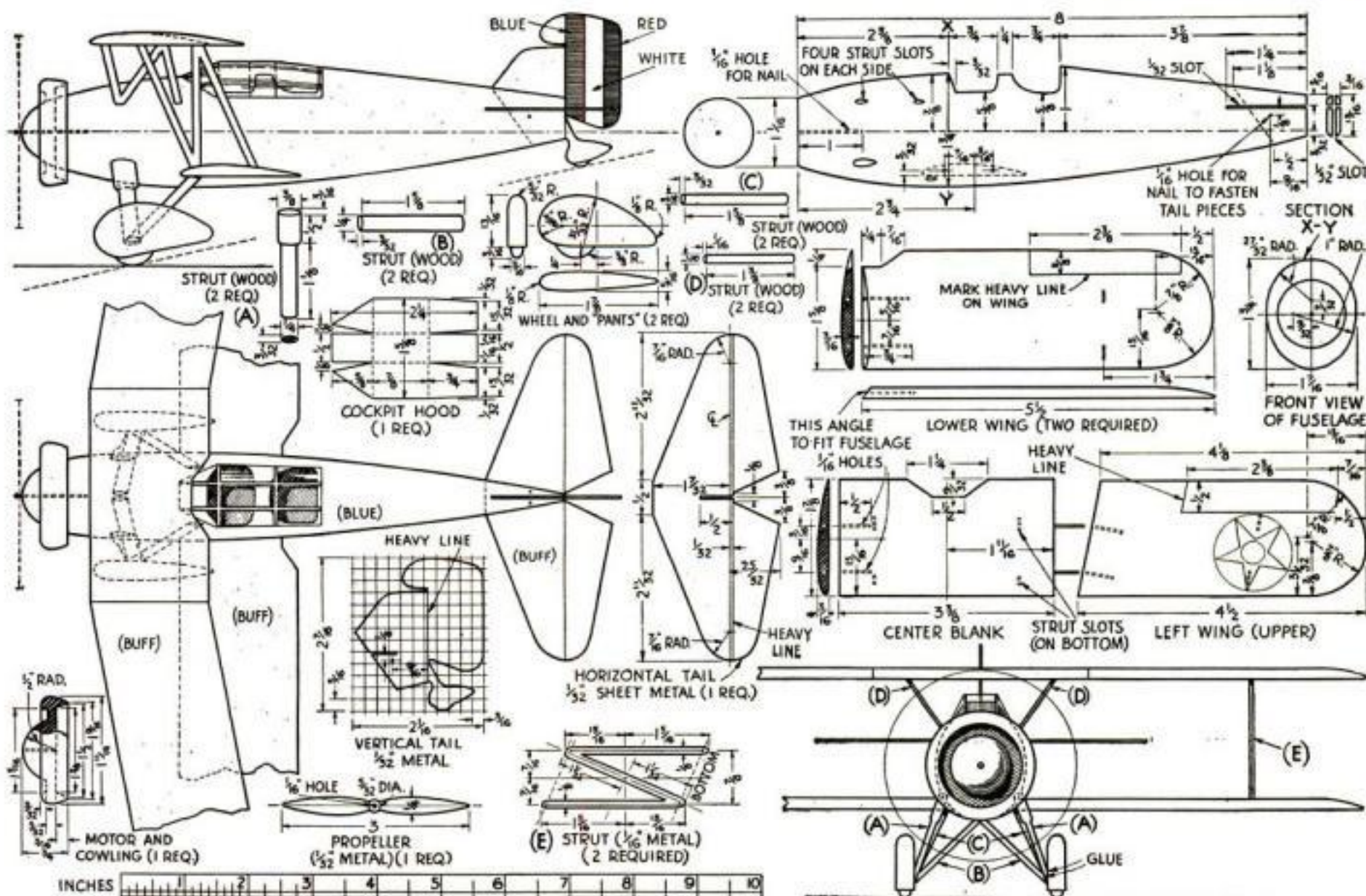
SO WELL has the Curtiss Hell Diver maintained its fame and popularity as a fighting plane, that many readers have asked us to include a $\frac{3}{8}$ -in. model of it in our series. Plans have therefore been worked out for it uniform with those

previously published for other outstanding airplanes. The model has been so simplified that it requires only the few parts shown in the upper photograph.

Either balsa wood or soft white pine may be used for the fuselage. If neces-

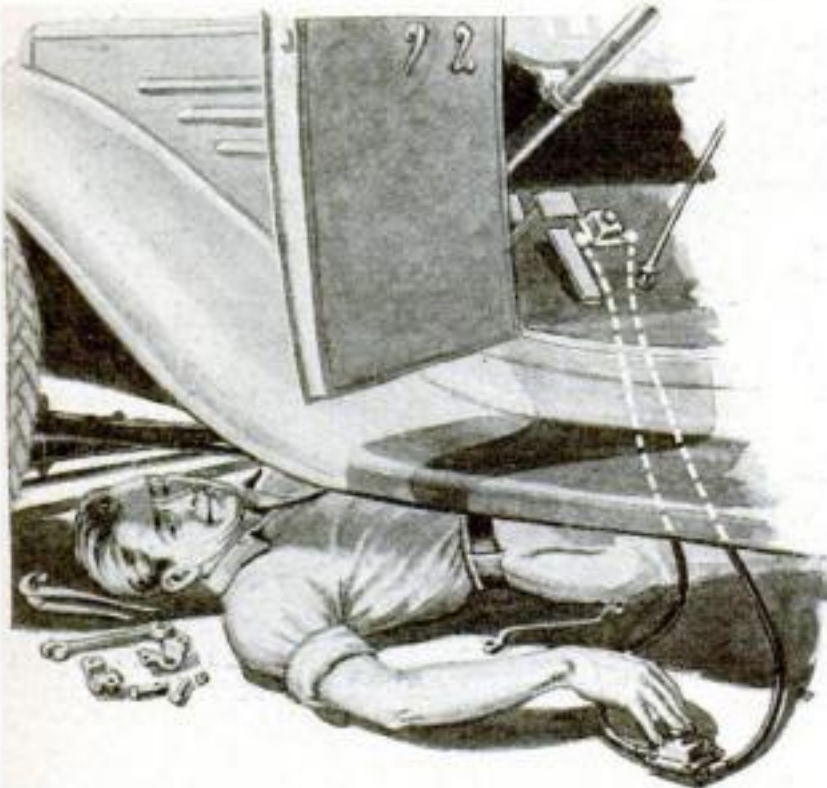
sary, two or more pieces of pine may be glued together to get the desired thickness. The fuselage should be sawed out and rounded, the tail slots cut with a hack-saw blade, and the cockpits cut and filed. Celluloid or cellophane is used to cover the cockpits, with balsa wood strips for support, as described later. The cowling is turned on a lathe if one is available; if not, it can be made of balsa wood.

On each end of the wing blanks, mark the wing section and plane down to these lines. It is best to make the wings, top and bottom, in one piece each. Cut the top wing, which should be about $13\frac{1}{2}$ in. long, into three pieces. Keep well away from the lines to allow for filing and the proper sweepback. The bottom wing should be about $11\frac{1}{2}$ in. long, cut in half and shaped to the curves of the fuselage. This can [\(Continued on page 107\)](#)



Useful Kinks for Motorists

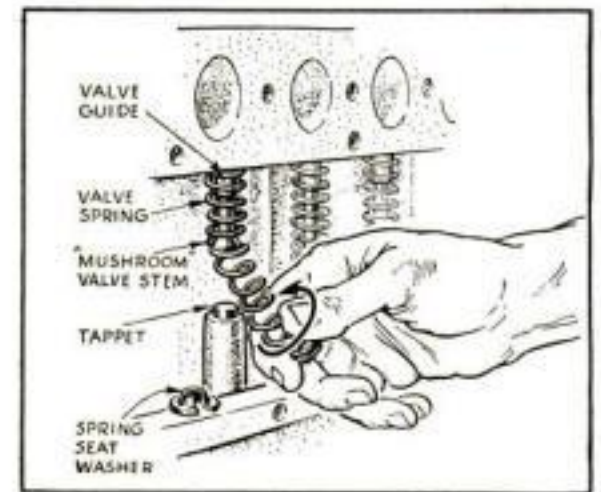
Starter Motor Turns Crankshaft During Repairs



With cables attached to starter motor and a switch handy, it is easy to turn the crankshaft while working under car.

WHEN work is being done on connecting rod bearings, it is necessary to change the position of the crankshaft from time to time. This means that if the home mechanic is working alone, he must crawl out from under the car repeatedly to man the crank. I get around this by using the starter motor as outlined in the sketch. First, I connect a spare starter pedal switch to two pieces of heavy cable. Then I wire the two remaining ends of the cables to the starter switch on the car. By making the cables long enough, I can operate the starter motor from any position. To reduce the load, I unscrew several spark plugs.—L. VAN T.

Suggestions from Our Readers That Will Help All Who Work on Autos Make Their Repairs Quicker and with Less Effort



Twisting Big Help in Removing Valve Springs

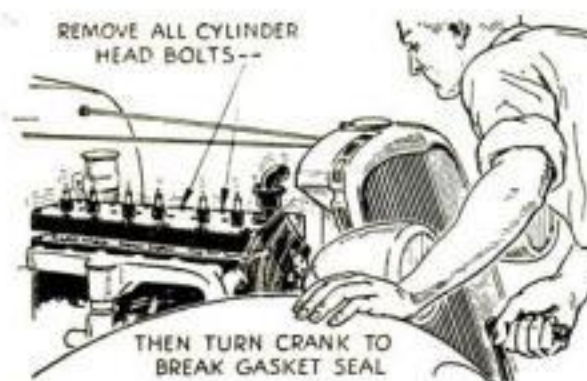
ON CARS having mushroom type valves, removing the valve springs sometimes proves to be quite a job. Generally, this is caused by the fact that the spirals of the spring catch on the grooved end of the valve stem. Instead of resorting to prying and pulling the next time this happens, simply twist the spring as you would in loosening a screw. The tip of the valve stem will follow along the pitch of the spring, forcing the spring free.—C. B.

Balancing Repair Boot

WHEN a repair boot is applied to a break in the shoe of a front tire, a certain amount of weight is added at that point and a shimmying front wheel may result. To avoid this, place two boots in the casing, one over the break and the other at a point directly opposite the break. This will add weight at two points, 180 degrees apart, with the result that each boot will counterbalance the other.—J. E. H.



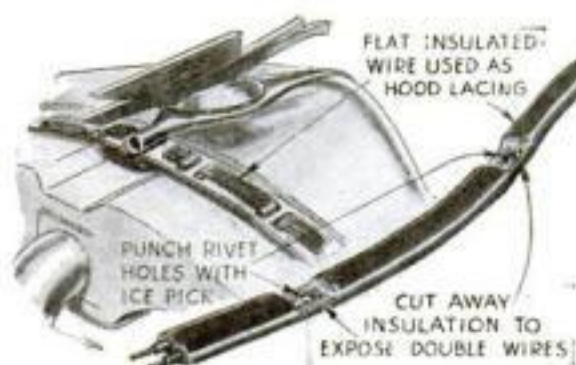
Illustration shows how second boot is added to counterbalance repair boot and prevent shimmying.



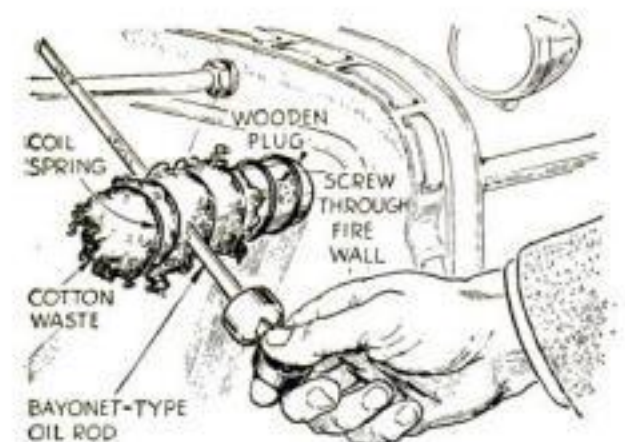
With the cylinder-head bolts removed, compression can be used to break gasket seal.

Squeaking Hood Due to the Worn Laces

IF YOUR hood squeaks, nine chances out of ten it is caused by a worn hood lacing. If no web hood lacing is handy for a replacement, you can use a length of insulated wire of the flat, two-wire type to make the repair. Simply cut away the insulation at the points where the rivets are to go, spread the two wires with an ice pick or other pointed tool, and insert the rivets.—R. R.



Hood squeaks, caused by a worn lacing, can be easily cured as illustrated. Insulated wire in this case is used in place of usual lacing.

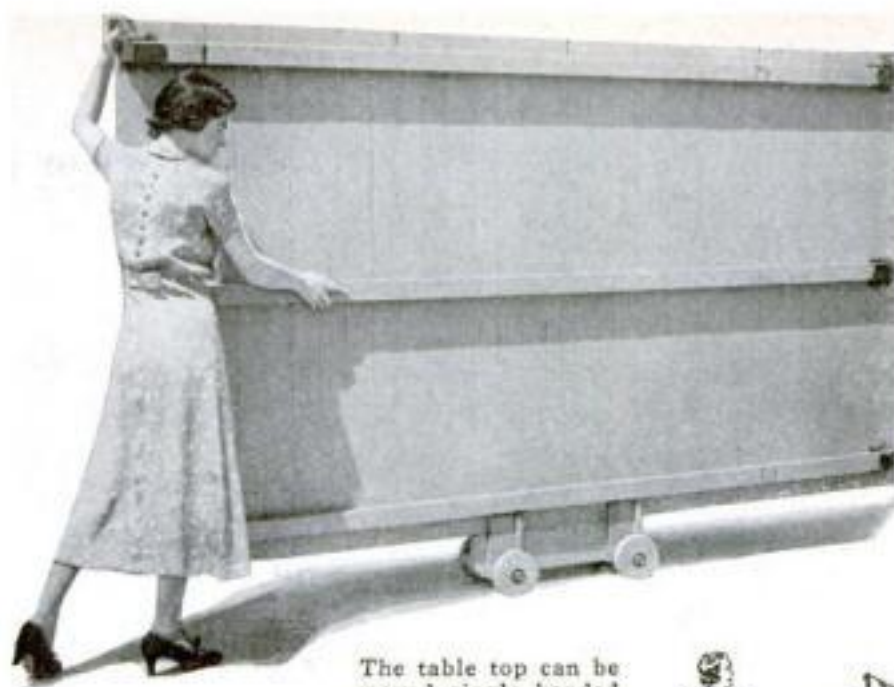


Coil Spring and Waste Makes Oil Rod Wiper

A STIFF coil spring stuffed with cotton waste and mounted on the rear partition of the motor compartment on your car will serve as a handy oil gage wiper. Simply sticking the oil rod through the waste will wipe it clean and allow an accurate oil level reading to be made. Being housed in a spring, the waste can be renewed easily. A cylinder of wood forced into the rear of the spring and held with staples will make it possible to fasten the wiper in place with a screw.—R. P.

Uses Compression to Break Gasket Head

BREAKING the cylinder-head gasket seal when making repairs will be greatly simplified if you will rely on the force of compression of the motor instead of your own muscle. Simply remove all of the cylinder-head bolts and, leaving the spark plugs in place, give the motor a few turns with the crank or the starter motor. Enough pressure will be generated inside the cylinders to break the seal and loosen the head. Many times the gasket can be used over again.—M. L. W.

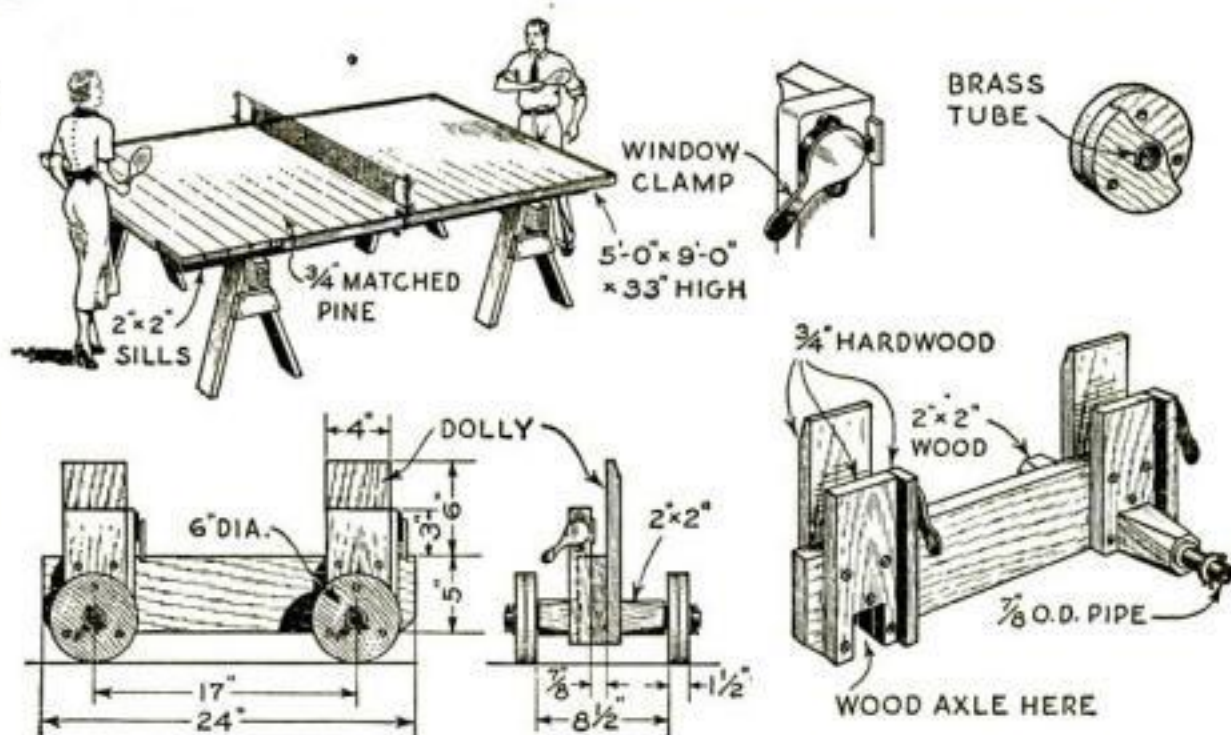


The table top can be moved single handed

A FULL-SIZE table-tennis or ping-pong table requires considerable floor space, but by building it according to these drawings and making a small truck or dolly for moving it, the storage problem is easily solved.

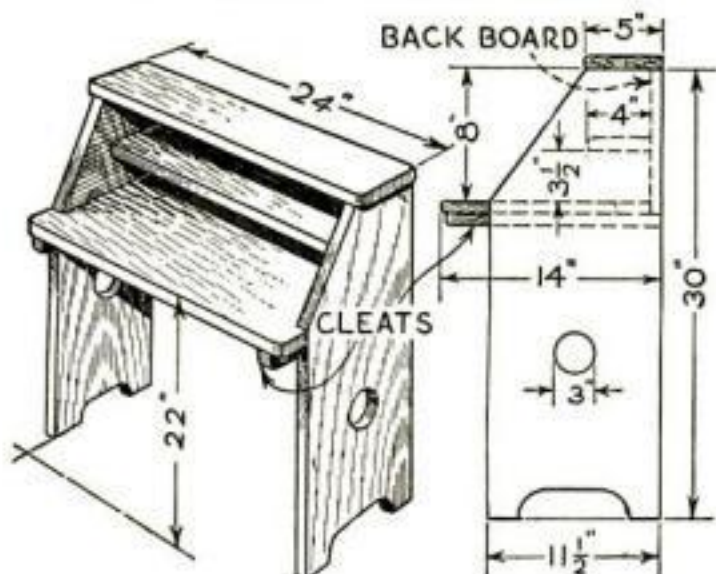
The table top, 5 by 9 ft., is constructed of matched pine and assembled on three 2 by 2 in. sills. A molding is put around the edge, flush with the top, and the top is planed and sanded. A dark green will be found a restful color for the eyes. The top rests upon two sawhorses of standard construction.

The dolly has a short wheel base, therefore it is easy for a woman or child to move the top in and out of the garage. By tilting up one end as it rests on the dolly, thus bringing one pair of wheels off the



How the top of the tennis table is made and set up on two sawhorses; side and end views of the dolly, and sketches showing method of assembly, clamps used, and the wheel construction

EASILY ASSEMBLED CHILD'S DESK



ALTHOUGH it will give years of pleasure, this child's desk takes only about half a day to make. It resembles a slant-top desk in appearance, but has been simplified to save time.

A few 1 by 12 in. boards, when surfaced on all four sides, will be just the right size. Clear, well-seasoned wood is the best to use. The desk top can be pieced out in the back as shown, or

a wider board may be used. The back board is important because it stiffens the end boards that form the legs.

Round all corners, sandpaper carefully, and paint the desk. You will find it an attractive, as well as useful, piece of child's furniture.—HUBERT KIDDER.



The desk in use and drawings of its construction, with suggested dimensions

PARAFFIN SEALS PHOTOGRAPHIC DEVELOPERS

IN KEEPING stock solutions such as photographic developer, which oxidize in contact with the air, it is essential to have an air-tight seal. An entirely satisfactory seal can be formed without the use of rubber stoppers by inserting ordinary corks rather

tightly and then immersing the cork and mouth of the bottle in warm paraffin. The paraffin should be no hotter than necessary to melt it, as there is danger of breaking the bottle if it is applied too hot.—J. W. EIDSON.



Asbestos rope is laid in the groove of the flue cover to prevent soot from leaking out

SOOTPROOF COVER FOR FLUE IN CHIMNEY

THE ordinary thin tin cover used over flue openings in chimneys does not always prevent fine soot from leaking out. Any unevenness in the wall surface, weakening of the spring, and contraction and expansion of the tin will spring the edge of the cover out just enough to permit an unsightly and almost unremovable blur of soot on the wall around the lower part of the hole. To prevent this, lay a length of 1/4-in. asbestos roping on the inside of the circular piece of tin in the groove at the outer edge. A thin layer of glue can be applied to the tin to hold the roping until the cover has been pressed into place. It will then be found that no soot can escape to leave marks on the wall.—FRANK W. BENTLEY, JR.

Brilliant Big Enlargements

Made By New
Grainless Developing
Process

BY KENNETH MURRAY

BY MEANS of a new type of photographic developer, an ordinary box-camera negative can now be treated so as to stand enlargement up to 10 by 15 ft.—big enough to cover one wall of the average room. What is even more extraordinary is that the enlargement will still retain the brilliancy and detail of a contact print.

Those amateur photographers who read the article by Frederick D. Ryder, Jr., on the fine-grain development of negatives (*P. S. M.*, June '34, p. 84) will be enthusiastic over the perfection of this new developer. Negatives developed with it can be enlarged over forty times *without grain*. Unless you intend making photo wall murals such as appeared at the Century of Progress Exposition this year, you will have no need, however, for enlargements of such mammoth size. The real thrill will come from making big enlargements from tiny, interesting portions of either regular or miniature-size negatives. Exposures are made in the usual way without increasing the time.

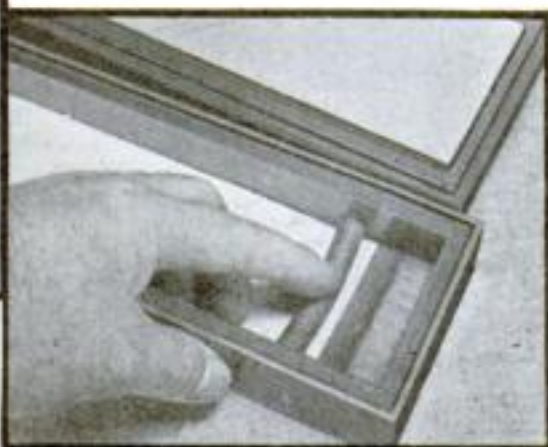
You can make the developer yourself without trouble, but an understanding of its action is first desirable. Regular developers, whether of the "fine-grain" variety or not, increase the size of the microscopic grains of silver in a negative. The new developer does not. Its action is phys-



What the amateur photographer can accomplish in making grainless enlargements is illustrated by this remarkable example. At the left is a reproduction, actual size, of a print made from a film developed in the new way. Above is an enlargement of part of the film



Developing tank made of wood. It is coated with dark lacquer or asphalt varnish. The ends of the film are fastened down by wedging short pieces of rubber tubing over them, as shown at the right



ical and it makes each silver grain opaque by a "plating" action, just as if you were to place a teaspoon in a silver-plating bath. Another peculiarity is that it is possible to fix the film in hypo before developing it instead of afterwards.

You can develop the films by

hand in a tray or a jelly glass, but as this is tedious, a simple wood tank is recommended. The one in the illustrations was made of $\frac{3}{8}$ -in. plywood and is 1 in. longer than the film strip. It is deep enough to hold a roll of film flat on the bottom and sufficient developer to cover the film. Short pieces of rubber hose wedged in the ends will hold down the ends of the film. Both the lid and the mouth of the tank are rabbeted to form a light trap. The parts are put together with short nails and waterproof casein glue, after which the tank must be given several coats of dark lacquer or a coat of asphalt varnish. The light trap should be coated with non-reflecting black wall-board paint. In no case should a metal tank be used, unless the metal is stainless steel or all of the metal parts can be conveniently waterproofed with varnish or lacquer. Contact with any metal but stainless steel will spoil the developer, and the negatives too. (*Continued on page 92*)

For exacting
amateurs

RECOMAR

most versatile of Kodaks

A PRECISION camera . . . European type—the Kodak Recomar truly meets every photographic test.

Its Compur shutter splits a second into 1/250 (1/200 on the Recomar 33) . . . provides seven other accurate automatic speeds . . . has a built-in self timer. The Kodak Anastigmat f.4.5 lens makes brilliant pictures under difficult light conditions.

Has double-extension bellows . . . micrometer screw focusing . . . hooded ground-glass focusing back . . . rising front . . . both eye-level and reflecting finders . . . spirit level. Supplementary long-focus and wide-angle lenses, extra. Uses plates, cut film, or film packs.

Covered in leather—the Recomar comes in two sizes. Model "18"—for 2 1/4 x 3 1/4 inch pictures, \$46 . . . model "33"—for 3 1/4 x 4 1/4 inch pictures, \$55.

The long, double-extension bellows allows you to make close-ups . . . copies. The hooded ground-glass back insures micrometer-sharp focus. Supplementary lenses for the Recomar cost \$3.50 each.



A WIDE CHOICE OF FILMS . . . Film packs, cut film, or plates may be used in the Kodak Recomars. Kodak Verichrome, "SS," or fine-grain Panatomic Films are available in packs. Cut films and plates may be had in a complete range of emulsions. *Snapshots at Night* . . . The fast lens (f.4.5) lets you in on the latest indoor sport . . . snapshots at night. Two or three inexpensive Photoflood bulbs . . . Kodak "SS" Film . . . and you're ready to make snapshots . . . indoors . . . at NIGHT.



The wide-angle supplementary lens increases the angle of view 23% on the Recomar "33" . . . 17% on the "18."



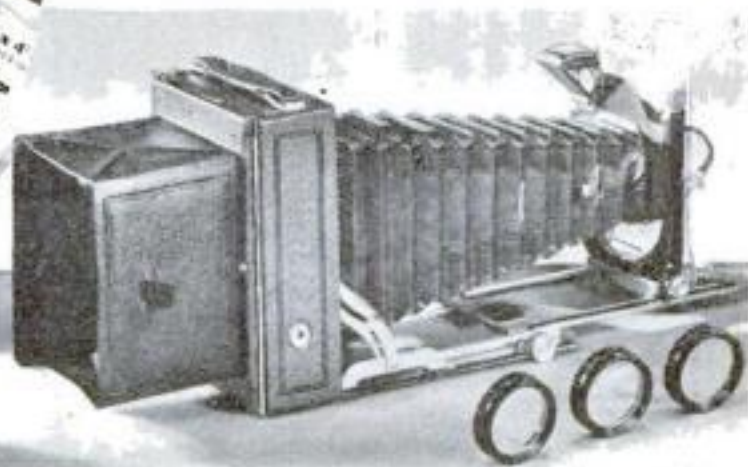
Normally—the Recomars cover this field. The model "33" has a 135 mm. lens . . . the "18," a 105 mm. lens.



With supplementary lens A—Recomar "33" gives a 33% increase in the image size . . . the "18," a 28% increase.



With supplementary lens B—Recomar "33" gives a 70% increase in the image size . . . the "18," a 62% increase.



FREE . . . more details

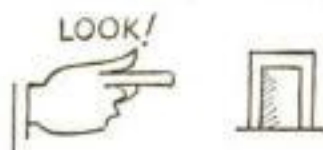
Mail this coupon for complete information about the Kodak Recomars . . . other Kodaks . . . and Kodak equipment. Eastman Kodak Company, Rochester, N. Y.

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IF IT ISN'T AN EASTMAN, IT ISN'T A KODAK



Shaving's a tough task... and that tough, oily jacket is what makes any whisker a tough customer to handle.

Once you strip that waterproof jacket from every single whisker, you take the fight out of your beard, and the scrape and pull out of shaving.

But—here's where most shaving creams fail you. They can't remove *all* the waterproofing. Because they froth up into *big-bubble* lather—and you can't get a lot of *big* bubbles close around every whisker.



But Colgate's Rapid-Shave Cream is different. Because it whips up into *small-bubble* lather. Whole armies of these tiny bubbles crowd close

to every single whisker. They strip it clean of every last trace of waterproofing. They *emulsify* the oil—float it away.



Then countless millions of these tiny bubbles attack each whisker, *wilt* it limp as a wet rag... soak it *soft* as melted butter... and turn your beard to fuzz beneath your razor.



Give Colgate's Rapid-Shave Cream a try. Find out for yourself how its *small-bubble* lather makes shaving easier... makes your razor cut slicker, cleaner. The large 35¢ tube is now only 25¢. Buy it... today!

P. S. Colgate's After-Shave Lotion and Colgate's Talc for Men give you the perfect finish to that Colgate shave.

LARGE SIZE TUBE

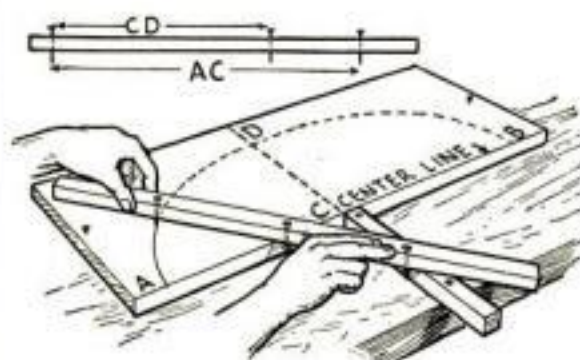
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make shaving easier

LAYING OUT AN ELLIPSE WITH WOODEN STRIPS

WOODWORKERS sometimes have to lay out a large ellipse. This may be required for an arched trellis or other garden work, or even for a piece of furniture such as the scoop-seat stool described in a previous issue (P.S.M. Feb. '34, p. 80). An easy way to do this is shown in the accompanying illustration. Lay



While two of the nails are kept in contact with the axes, the third marks the ellipse

out the two axes at right angles to each other. Nail a strip of wood above the long axis (or use the long edge of the board to be cut) and one short strip to the right of half the short axis. Make a marker from a third strip of wood by driving brads through it spaced as indicated. By holding the two brads that are closest together against the strips nailed along the axes, the third nail will mark the desired curve. Then shift the short strip over to the left side of the axis and draw the other quarter of the ellipse.—H. H.

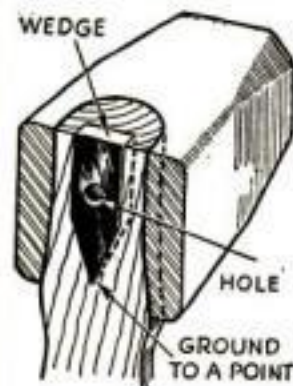
PORTHOLES ON MODELS PAINTED WITH STICK

A SMALL wooden dowel, sandpapered at one end to the desired diameter, forms a good tool for painting the portholes on miniature ship models such as the *Indianapolis* and the *Manhattan*. The shape and method of using the stick is shown in the diagram. To avoid getting too much paint on the dowel, thus causing a blot on the ship, use thick paint. —JOHN H. DIVEY.



Using pointed stick to paint portholes

WEDGING TOOL HANDLES



IF A PLAIN steel wedge is used in tool handles, grind the thin edge to a point, as shown, and in the body of the wedge drill a hole at approximately the center. It will hold more firmly than even a notched or corrugated wedge. I use a "driver" for barrels and kegs, and

the hammer handles always came loose, regardless of what wedges I used, until I tried this type. They are made in this instance from worn-out blades of heavy-duty can openers.—CHARLES L. H. INTERNANN.

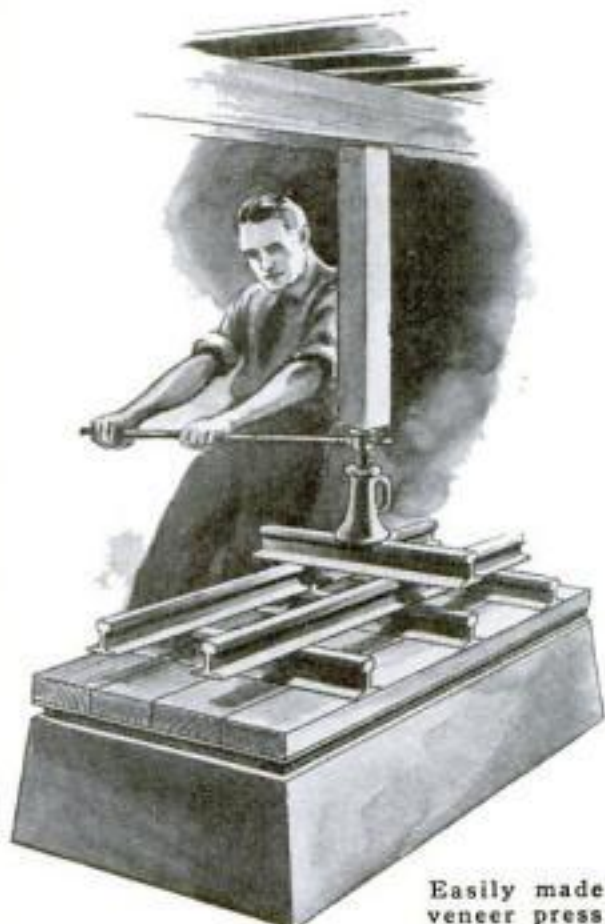
ROLLING-PIN SQUEEGEE

For rolling wet photo prints on squeegee plates, an ordinary wood rolling-pin is heavier than the usual small hand roller, and its greater diameter makes the work easier.—N. N. E.

JACK GIVES PRESSURE FOR VENEER PRESS

IF THE lack of a press retards you in doing veneer work with the large variety of beautiful veneers on the market and now so easily obtained, you can devise an inexpensive press of your own by one of the following methods.

If your shop is in a basement with a floor of earth or concrete, cast a concrete bed large enough in surface area to hold any work you may want to do, and of a height to suit your convenience or in proportion to the ceiling height. It is suggested



Easily made
veneer press

that only a very liquid cement and sand mixture be used for the top coat, which should be 3 or 4 in. thick. This is self-leveling.

Cut iron rails, if they can easily be obtained, in such lengths that they will form a crib in the shape of a pyramid, as illustrated. In place of iron, wood 4 by 4's or 4 by 6's may be used. This crib goes on top of a mat made of planks of sufficient rigidity to apply pressure evenly over the surface of the work. A piece of wall board should be placed between the work and the mat.

Between the top of the crib and the bottom of the ceiling or floor above, place an automobile or screw jack for applying pressure. A screw jack is easier to handle. If the distance from top of the bed to the ceiling is too far to build a crib for use with the jack, the space can be adjusted with a wooden column—a length of 6 by 6 or 8 by 8.

Instead of a concrete bed you can, of course, place the work directly on a level concrete floor, but it will not be so convenient. Where it is impractical to pour the concrete, a heavy wooden bench can be made. This must be very rigid and have six or eight legs.

If preferred, a concrete slab with four ringbolts can be cast and used instead of a crib when applying pressure. Pulleys and ropes will make it easy to handle this slab.—L. W. HENDERSON.

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*and you free
his mind!*



This fall give that youngster the gift of freedom from the cramping slowness of his own handwriting.

A Corona speeds words, work, thought, mind. You learn quickly. You write tirelessly. The sheer

delight stimulates your thinking.

Try it. Borrow a Corona portable typewriter at your dealer's for a week. And ask him about the partial-payment plan that makes owning a Corona so easy.

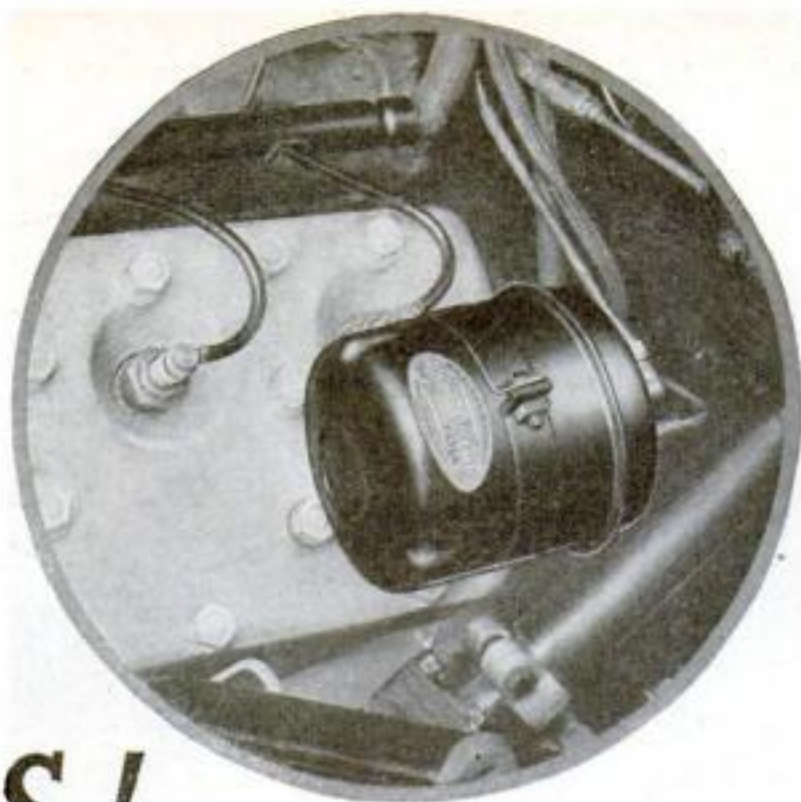
About Corona: All Coronas are portable—but not all portables are Corona. There are Corona models from \$24.50 to \$60. The longest experience in making portable typewriters is back of every one. Interesting booklets sent free on request.

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This is in answer to the many inquiries that come to us from Ford and Chevrolet owners.

Fords and Chevrolets are not equipped with an oil filter at the factory . . . but your own service garage is now prepared to furnish and install a Purolator Oil Filter . . . *especially designed and engineered for these two jobs.*

AND YOU COULDN'T MAKE A BETTER INVESTMENT

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Your Purolator will catch and hold the dirt and grit and fine metal particles and hard carbon that settles in crank case oil . . . will keep these grinding, abrasive substances out of the oil stream and away from your engine . . . will lengthen its life and its smoothness of operation.

It is these destructive settlements that wear out bearings, score cylinder walls . . . cause costly repairs and replacements . . . send many a car to the junk heap, long before its time.

The economy, the long life and the satisfying smoothness of operation developed by the use of a Purolator Oil Filter is already known to millions of experienced motorists. For its use as original equipment is no longer confined to high-priced cars. Apart from these two makes, more than 70% of all cars sold in this country during the first six months of 1934 left the factory equipped with a *genuine* Purolator Oil Filter.

The cost of a complete Purolator Filter, especially designed for Ford and Chevrolet passenger cars or trucks and including all the necessary fittings, is only \$5.00, plus a small charge for installation.

It will pay for itself many times over . . . both in actual dollar savings and in satisfaction.

If your own favorite service garage hasn't yet been supplied with this material, just clip and mail this coupon.

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CELLULOID TOYS SERVE AS DRAWER PULLS



AFTER building a child's combination desk and bookshelves, I was at a loss to find appropriate drawer pulls until I chanced upon the idea of using the heads of small celluloid animals. After purchasing several different animals, I cut off the heads at the shoulders and filled some with a plastic wood composition and some with plaster of Paris. While the filling was still soft, I inserted the head of a common screw hook with the screw projecting. The plastic wood composition, I discovered, made a harder and lighter pull, but left the celluloid soft for a time.

I have also used the head and neck of giraffes fastened to a screw eye for a coat hook, and the bodies of animals cut in half lengthwise for handles on chests and relief work on boxes and furniture.

Another use of celluloid is in making attractive pendants from natural flowers. Small, compact flowers give the best results. The celluloid for this use may be dissolved in acetone or in several of the common paint-and-varnish removers or solvents sold to soften plastic wood compositions. Cut scrap celluloid into small pieces and place them in a large-mouthed bottle that can be corked tightly when not in use. Pour some of the liquid on them and set away until dissolved. The mixture should be about like heavy liquid glue.

Cut off the stems of the flowers to be treated close to the base and insert a sharpened match stick to hold them by. The first



Celluloid pendants of
begonia and wild sedum

application of celluloid may be put on by dipping the flower and brushing the excess around until it starts to set. Blow on it gently and it will gradually stiffen so that additional coats may be added with a brush until the desired thickness is obtained.

Two styles of loops may be used. One is made of a short strip of celluloid inserted in place of the match stick. A copper wire ring is inserted through a small hole in the strip. Coat the wire with celluloid after it is in place. The other loop is made of two narrow strips of celluloid cemented together, bent U-shaped, and then cemented to the stem.

After the pendants are dry, they may be treated with penetrating wood stain, or a greater variety of tints may be had by using egg dyes. It is advisable to use a staining liquid that will penetrate the celluloid slightly and not chip off.—JOHN MCGLOSSON.

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MARKING PATTERNS FOR CURVED SURFACES

IN CARVING the ornamentation on furniture or other objects, it is often necessary to make several parts alike. To do this properly, especially if the design is intricate, a marking pattern must first be prepared. It is easy enough to cut a pattern for a design on a plane or a cylindrical surface, but not for a surface that curves more than one way, like that of a turned vase or lamp base, or the upper part of a Queen Anne post for a stool or bench. A piece of paper or cardboard cannot be cut to fit such forms, but gummed



Gummed paper tape is applied to the surface over a layer of tissue paper. This forms a shell

paper tape, like that used by merchants to seal packages, can be made into very good patterns for such jobs. It should, however, be cut quite narrow, from $\frac{1}{8}$ to $\frac{1}{4}$ in.

First, cover the portion of the wood that is to be carved with thin tissue paper. Just press it on firmly; the wrinkles will be too thin to hurt. Moisten a narrow strip of the gummed paper and lay it across the tissue paper. Let it extend a little beyond the edges of the tissue paper, so that it clings to the wood at the ends and holds both itself and the tissue paper in place. Then, in the same manner, lay on other strips, both crosswise and lengthwise, all over the surface to be carved, until you have built up a shell thick enough to serve as substantial material for the marking pattern. Outline the design on this shell of gummed paper and cut it out with a sharp-pointed knife or a small chisel. The pattern may then be lifted from the wood, as the tissue paper beneath it prevents sticking. The gummed paper left around the edges may be scraped from the wood with a knife or scraper, and the wood touched up with sandpaper.

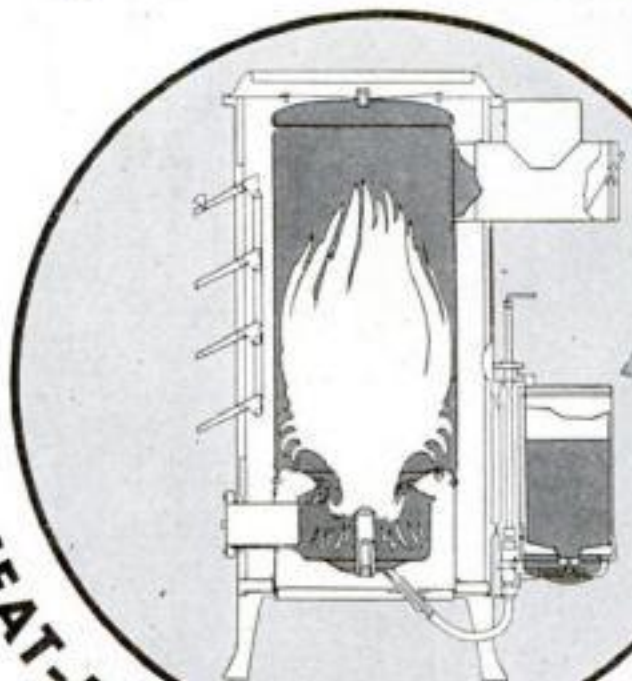
A marking pattern carefully made in this way holds its shape well and fits snugly over the surface for which it was designed. It is, indeed, very easy to use.—BASIL CLARK.

GLASS JAR KEEPS WOOD COMPOSITION FRESH

WHEN wood composition of the nitro-cellulose solvent type will not be used entirely within several months of opening the can, the contents should be removed and placed in a glass jar with a tight lid. The half-pint jars in which mustard is sometimes packed are suitable for this purpose as they take a regular fruit-jar lid and rubber. The original containers are not so air-tight; besides, the solvent has a corrosive effect on the tin so that even if the composition is softened with solvent, it is likely to be found full of tiny particles of rust.—HAROLD R. SMITH.

For the first time a stove that **DIRECTS** the heat where you choose

• NEW HEAT-DIRECTOR BURNS OIL •



Heat-Director No. 100 Listed as standard by the Fire Underwriters. Diagram shows vaporizing burner, patented heat projectors and removable fuel tank.



Now you can enjoy winter-long comfort through directed heat! Radiant heat rays that warm every surface they touch, are sent out by the patented shutter-like heat projectors on three sides of the new Heat-Director. This radiant heat warms floor, footstool or easy chair, according to the angle at which you open the heat projectors.

The Superfex Heat-Director is simple, practical, trouble-free. Set it up and connect to a flue like any stove. There are no moving parts, nothing to get out of order. The powerful vaporizing burner responds instantly to a turn of the

valve, giving a wonderful heat volume in a hurry. It is easily regulated for milder weather. With the Heat-Director's flexible control, there are no sudden changes or extremes of temperature.

The removable fuel tank holds enough oil for as many as forty-six hours of comfort. Connections for outside fuel storage are also available.

See your dealer's display of Superfex oil burning heating stoves. There are seven models, three Heat-Directors and four Radiating heating stoves. Send today for our free booklet illustrated in color.

For one-room chilly spots, get a portable Perfection oil burning room heater.

SUPERFEX

Oil Burning HEATING STOVES

PRODUCT OF PERFECTION STOVE CO. *The Mark of Quality*

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Please send booklet on clean oil heat without a furnace.

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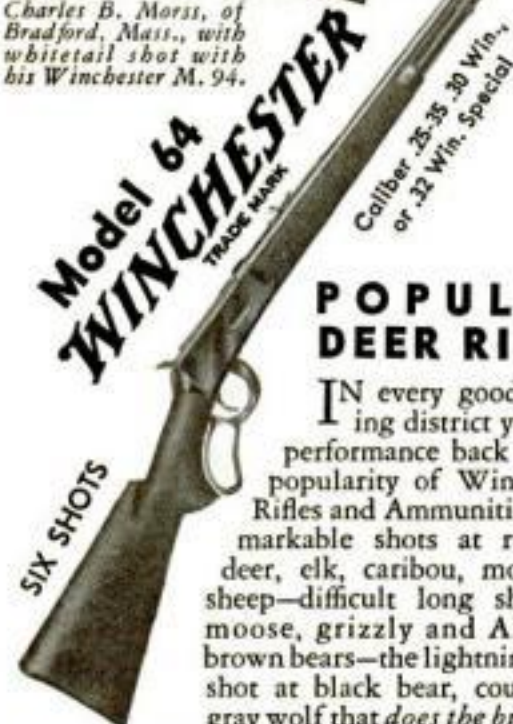


SEND FOR
FREE
BOOKLET

**What you GET
with them—you
buy for THAT!**



Charles B. Morris, of
Bradford, Mass., with
whitetail shot with
his Winchester M. 94.



POPULAR DEER RIFLE

IN every good hunting district you find performance back of the popularity of Winchester Rifles and Ammunition. Remarkable shots at running deer, elk, caribou, mountain sheep—difficult long shots at moose, grizzly and Alaskan brown bears—the lightning snap shot at black bear, cougar or gray wolf that *does the business*.

Examine this Winchester lever-action Model 64 Rifle, for deer and game of similar vitality. Newly developed from the famous Model 94 action. Stocked for better accuracy, whether snap shooting, rapid fire or taking your time. Well-curved pistol grip and deep, well rounded forearm . . . checkered non-slip butt plate with right pitch to stay put while you throw lead. Action and barrel precision-built Winchester proof-steel. Long-ramp front sight with Lyman Gold bead, quick-elevating rear sight of Rocky Mountain type.

STAYNLESS NON-MERCURIC CARTRIDGES

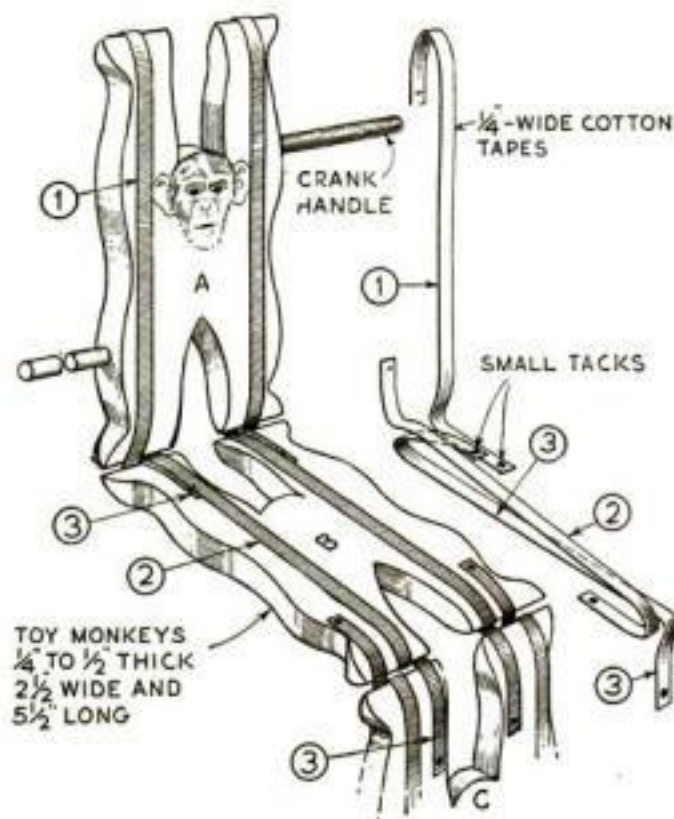
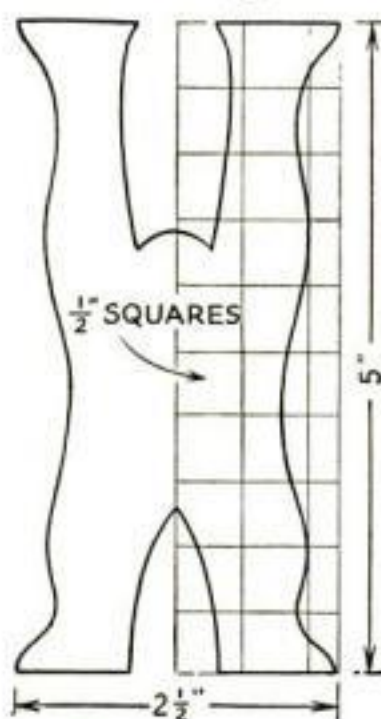
Equally important and as highly improved as the Winchester Rifle you select, Winchester Ammunition insures you superior service. Made side by side with Winchester Rifles for nearly three-quarters of a century. Dependable, lightning-quick response to the hammer. Highest velocity. Flattest trajectory. Utmost striking energy. Finest accuracy. And Staynless—*positively non-rusting*.

See them at your dealers'—TODAY
Ask for Model 64 Rifle folder—FREE

WINCHESTER REPEATING ARMS CO.
DEPT. 34-C NEW HAVEN, CONN., U. S. A.

Wooden Monkeys

PERFORM Acrobatics



Turning the upper block first one way and then the other makes the monkeys do an astonishing series of somersaults. The arrangement of tapes is shown above; the pattern is given at the left

This toy is well suited to window display purposes if it is made long enough so that it can be worked mechanically from above without being seen from the street. Any number of monkeys may be used. You can change the design to clowns or bears if you like,

or paint monkeys on one side and bears on the other, which makes the acrobatics even more mystifying.—CHARLES H. ALDER.

WHEN these acrobatic monkeys go into action, everyone wants to know what makes them work. First they hang by their hands and then, flop! and they all turn somersaults and hang by their feet! It's an old trick dressed up in a new way and quite mysterious even after you understand how they are constructed.

Each monkey—you can make as many as you please—is sawed from a piece of wood from $\frac{1}{4}$ to $\frac{1}{2}$ in. thick, $2\frac{1}{2}$ in. wide, and 5 in. long. Taper the ends with a block plane or wood rasp, and smooth with file and sandpaper. Stain or paint them brown, and then paint the faces, fingers and toes as suggested in the illustrations. Dowels $\frac{1}{4}$ in. in diameter and $2\frac{1}{4}$ in. long are glued into the first monkey as shown on the drawing (or a plain block instead of a monkey may be used as illustrated in the photograph).

The monkeys are fastened together with $\frac{1}{4}$ -in. cotton tape and small carpet tacks. Tapes No. 1 are nailed to the back of monkey A, then stretched over its front and nailed to the back of B. Tapes No. 2 also start on the back of A, pass over the front of B, and end on its back. Tapes No. 3 start under tapes No. 2 on the front of B, pass over its back, and end on the front of C, and so on. Each monkey, with the exception of the first and last, has a pair of tapes stretched both over its front and back.

To make them do stunts, turn the handles half a turn in one direction and then half a turn in the other direction. The faster you work, the faster they work.

HAT SUPPORT COMBINED WITH COAT RACK

DESIGNED to hold a woman's hat without touching the wall and getting out of shape, this hat and coat hook fulfills a double purpose and saves space in the clothes closet.

The metal part of the hook is made from a piece of strap steel or band iron, about 16 by $\frac{1}{2}$ by $\frac{1}{8}$ in. Before being bent, the iron may be hammer-marked, if desired, with a ball-peen hammer. Make the two 90-deg. bends in a machinist's vise and the circular bends over pieces of pipe of suitable diameter. Drill and countersink the necessary holes, and round off the coat hook smoothly with a file. Then clean the bracket with emery cloth, af-



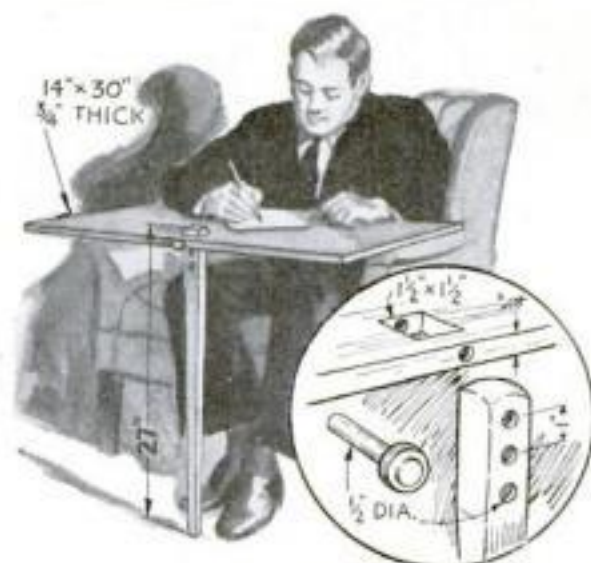


When the support is screwed to the hook rail in a closet, it holds both a hat and a coat

ter which it may be lightly oiled, waxed, lacquered, or painted.

The wooden block, $3\frac{1}{4}$ in. in diameter, is turned on a screw chuck and sanded, stained, and shellacked. It is fastened to the bracket with a single 1-in. No. 12 wood screw from below.—SAM LITTLE.

SIMPLE WAY TO MAKE AN ARMCHAIR TABLE



With this one-legged table it is possible to work in comfort while sitting in an armchair

ONE-LEGGED tables for use across the arms of an easy chair are usually made with a framed-up top and covered with fabric like a card table, but a much simpler way to construct one is shown in the accompanying drawings. Such a table enables one to write, draw, study, or play solitaire in comfort.

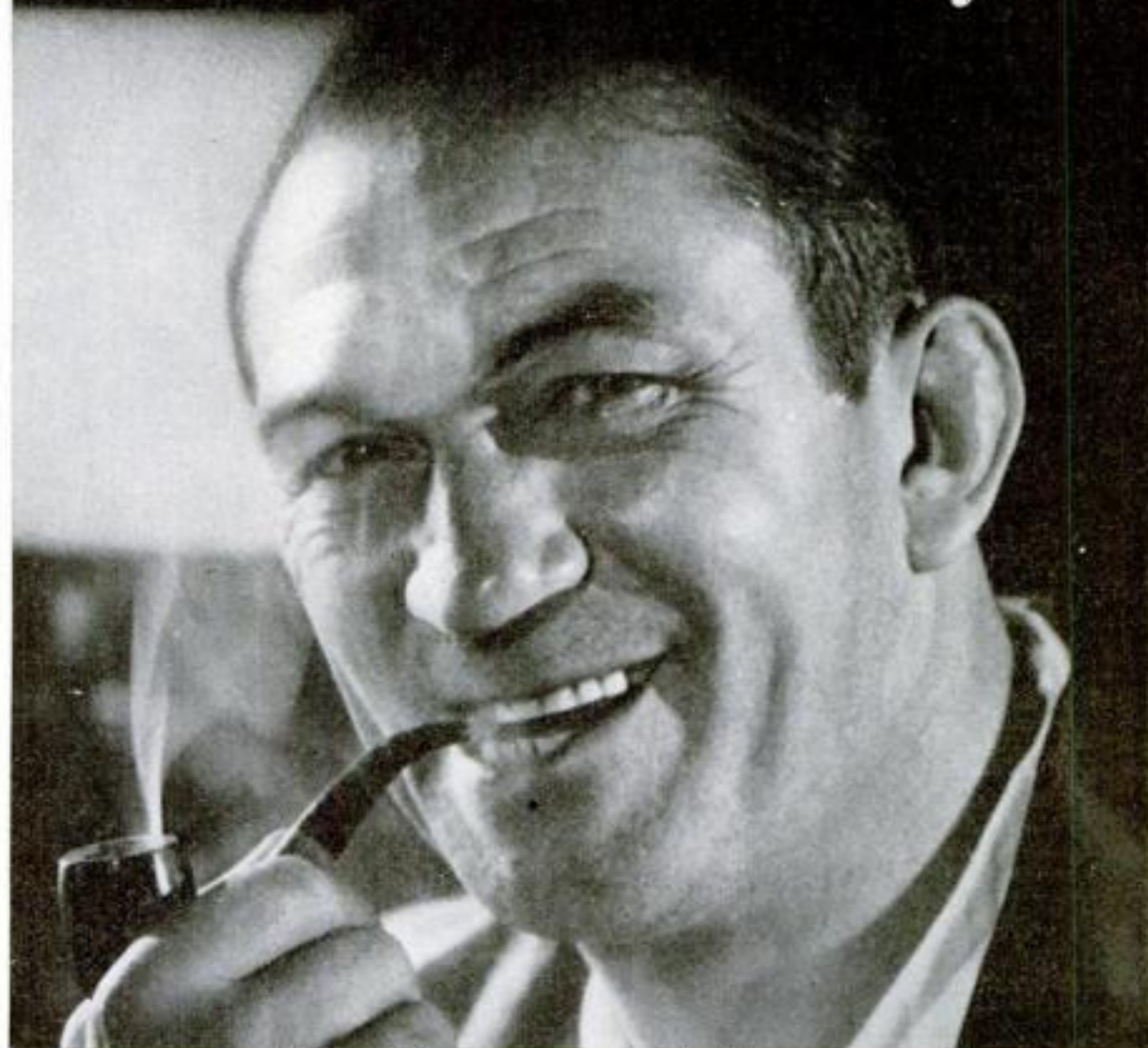
To prevent warping, the table top should be glued up of three boards 5 in. wide. It is planed, squared, and smoothed in the usual way. The edge may be left square, rounded, or reeded. The latter operation may be done with a scratch stock as described in previous articles (P.S.M., Dec. '33, p. 80 and June '34, p. 94).

The leg is squared to $1\frac{1}{2}$ by $1\frac{1}{2}$ in., and its lower part tapered as shown to 1 in. square at the lower end. Two or three holes $\frac{1}{2}$ in. in diameter, are bored for the pin to suit the height of the chairs on which the table is to rest.

A snugly fitting hole for the leg is then laid out on both the upper and lower surfaces of the table and carefully bored and chiseled. The pin is turned so that it fits snugly in the holes bored into the top and through the leg.

The table should be stained and finished to match the chair or other furniture in the room. It should be padded on its underside at the points where it rests on the arms of the chair.—HERMAN HJORTH.

*"I gambled a dime
and won a buddy!"*



VICTOR MCLAGLEN . . . popular Fox Pictures star

THE first Union Leader tobacco I ever saw was smoked by an extra, on location. He said he smoked it because he got so much for 10¢. But he looked as though he thoroughly enjoyed it, so I thought I'd gamble a dime and buy a tin

of Union Leader myself. I was not disappointed. Man! What mellow Kentucky Burley! Union Leader has been a buddy of mine ever since. It's much more appealing to my taste and costs much less than my former brand. (I like it in cigarettes, too.)

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THE GREAT AMERICAN SMOKE

10¢



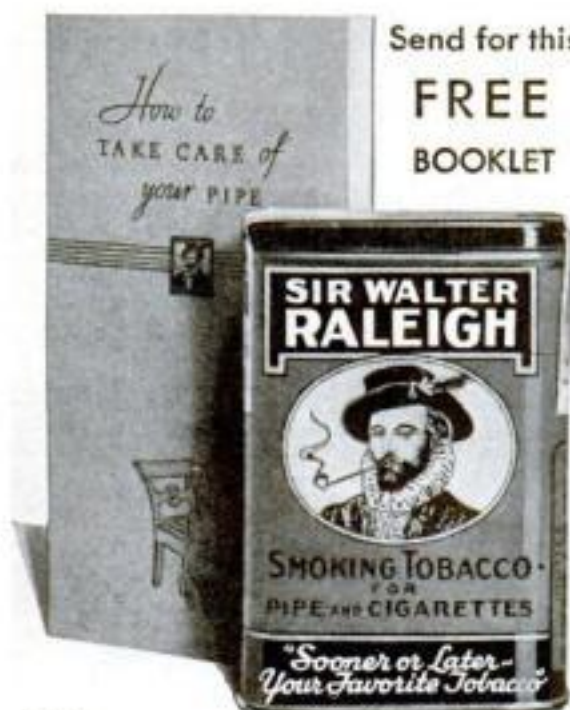
**K.O.'D BEFORE HE
LEFT HIS CORNER!**



STAGE-FRIGHT? No, sir. Dirty work in the dressing room? No, sir. Two or three whiffs of that over-stale pipe and heavyweight tobacco did what fifty-seven opponents couldn't do . . . floored him!

A good pipe, like a good athlete, should be kept in good condition. A few moments' daily exercise with a pipe cleaner and a steady diet of mild, gentle Sir Walter Raleigh Smoking Tobacco will keep any man's briar right in the very pink. We think we've found a milder combination of fragrant Kentucky Burleys. We think we've discovered a cooler, slower-burning blend. A large and growing army of contented pipe-smokers think so, too. Try one tin of Sir Walter and see what you think!

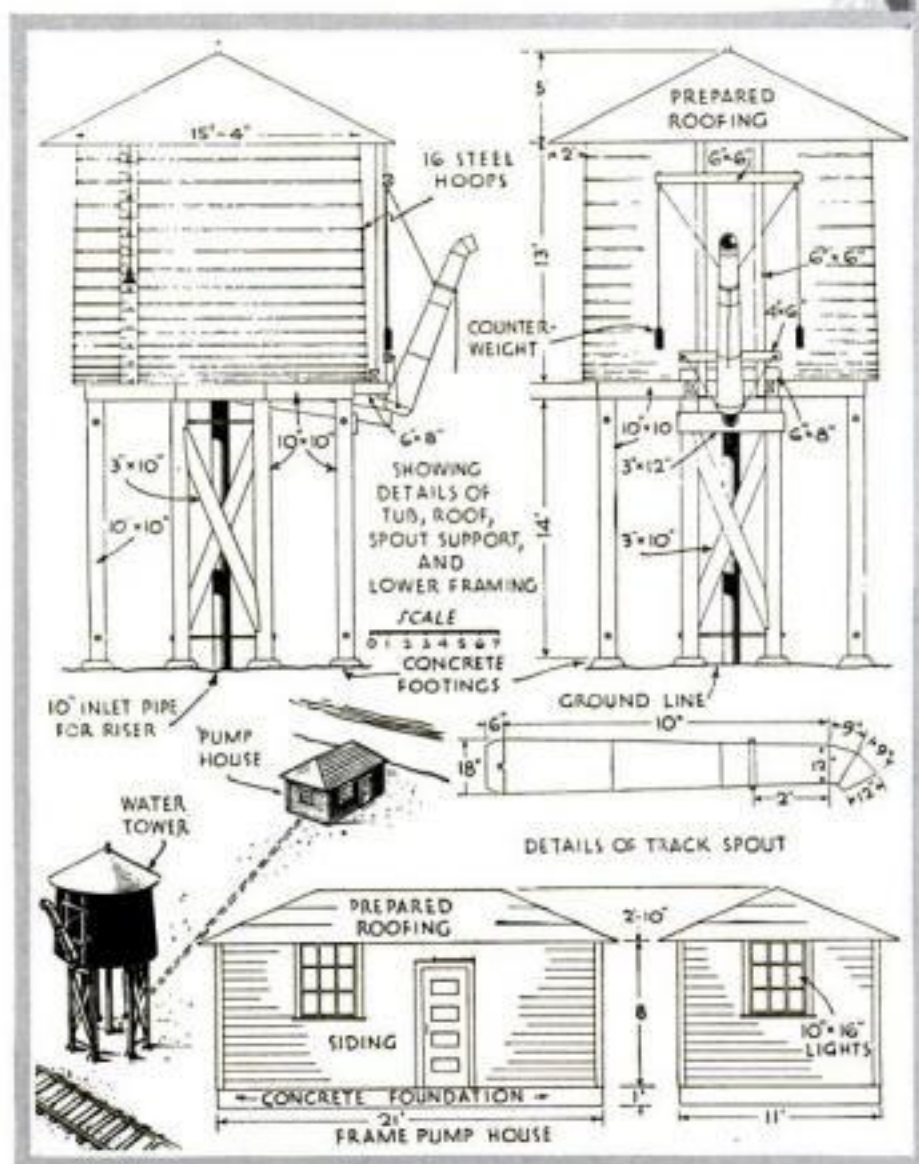
Brown & Williamson Tobacco Corporation
Louisville, Kentucky. Dept. Y-410.



It's 15¢—AND IT'S MILDER

Water Tank AND PUMP HOUSE

add realism to
Model Railway



From these drawings a water tank and pump house may be constructed in scale with whatever size model railway system your layout happens to be

By J. W. Clement

NO SINGLE piece of scenery adds quite as much realism to a model railway system as a water tank. Even though the tub is a solid wooden cylinder and the track spout only a dummy, it is a necessary unit for our station layout. The pump house is not essential, but it is so easy to make that it should not be neglected, especially if we can locate it on the bank of a stream or lake on the station grounds.

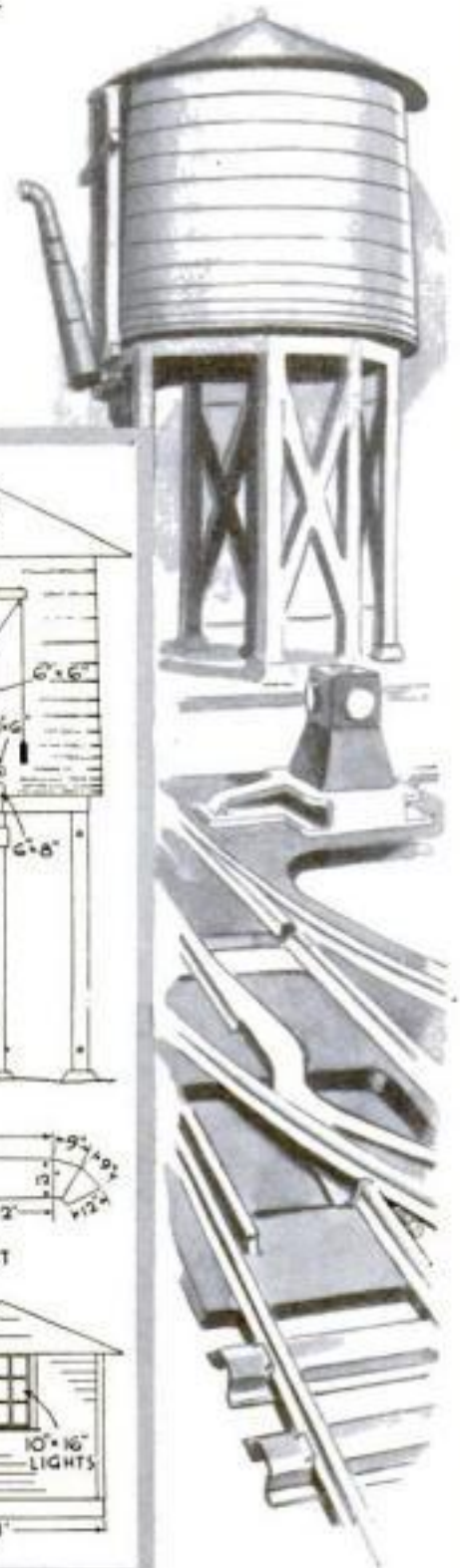
The plans for the tank are so complete that it may be necessary to eliminate some of the details when building to the smaller scales. However, it is much easier to omit details and simplify the construction than to improvise and guess at dimensions and parts when not shown.

If built to a scale of $\frac{1}{4}$ in. to the foot, the bottom of the tub will be 4 in. in diameter, the top $3\frac{7}{8}$ in. in diameter, and the height $3\frac{3}{4}$ in. from the bottom of the tub to the eaves. The tub and roof can be turned from one solid piece, if you have a lathe. Use some soft wood that is thoroughly dry and having as little grain as possible. The hoops, of which

there are sixteen, are small rubber binders, the smaller the better. These are stretched over the tub before the framework which supports the track spout is placed. Spacing the hoops should be left till just before the tank is painted. The paint will hold the hoops in place.

The frame supporting the spout should be made of slender strips of wood. Use real or dummy pulleys, as you prefer, for the ropes that support the spout.

The horizontal timbers under the bottom of the tank are represented by an octagonal block of wood $\frac{1}{4}$ in. thick. This block is centered under the bottom of the tank and held in place with three or four wood screws. After making sure that the block will fit, it is removed preparatory to fastening the eight posts in place. They are $\frac{1}{4}$ in. square and $3\frac{1}{2}$ in. long. It is best to assemble these posts in pairs and add the diagonal bracing and tie bolts before attempting to place them. After being assembled, they are fastened with brads driven down through the block and into the ends of the posts. There is an inclosed part under the real tank, but it has been omitted in the drawing. This is a



housing or frost box and is used only on tanks on the northern roads to protect the riser pipe from freezing.

The track spout could be made of wood, but will not appear very realistic. Thin tin, cut and soldered to shape, is to be preferred.

After the tank is completely assembled, the rubber binders, used for hoops, are spaced as

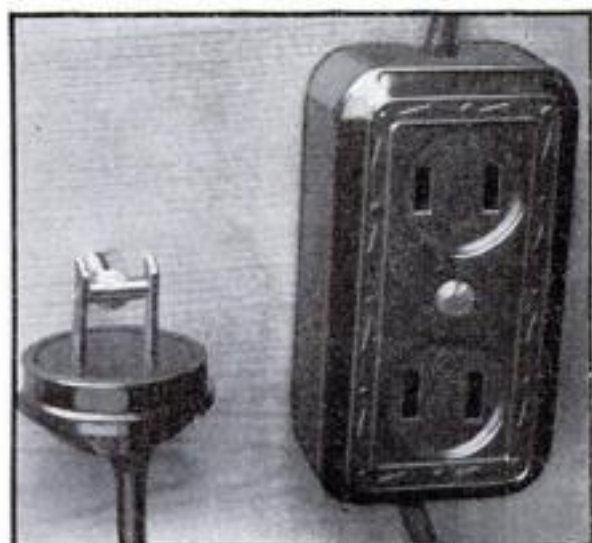


The actual pump house is beside a settling basin, but in a model the latter is omitted

follows, starting at the top of the tub: 4, 18, 16, 15, 14, 13, 12, 12, 11, 10, 9, 8, 7, 6, 5, 4, and 4 in., a total of 14 ft. The whole tank with the exception of the roof, spout, and riser pipe, is painted a rusty red. The spout and riser pipe should be painted a dull black and the roof gray. The center of the tank should be 19 ft. (to scale) from the center of the track.

Little need be said concerning the pump house. All necessary dimensions are given in the drawing. It is shown as a frame building, but may be covered with medium coarse sandpaper to represent stucco. In either case it should be painted to correspond with the other station buildings. In reality, this pump house is located on a settling basin, but there is rarely room for that on a model.

HOLDER KEEPS ELECTRIC PLUG READY FOR USE



When not in use, the plug is snapped over a short piece of nail soldered to a screw head

SEVERAL electric cords are often used around a plug-in receptacle over the bench. When not in use, they are likely to become tangled or mixed up with the tools. To prevent this, make one or more holders for the plugs as shown above. Cut off a piece of a nail and round the ends smoothly so that it will lightly snap into the holes in the prongs of the plug. Then enlarge the groove in a small wood screw, and solder the piece of nail to the head. Insert this screw near the receptacle so that the plug can be quickly pressed in place over the crosspiece as soon as it is pulled out of the receptacle.—F. W. B.

When ordering back issues of POPULAR SCIENCE MONTHLY, please send 25 cents for each issue except the current one and the three issues immediately preceding. These four issues are only 15 cents each.

He has two mothers



...but still he's lonesome

Johnny Rogers has two mothers. He sees his real mother for only a few moments each evening—because she has to work all day.

His substitute mother is *organized charity*, which does the best it can for him during the day.

If Johnny's father were alive, things would, of course, be different. But unfortunately he put off taking out life insurance; that is why Johnny's mother cannot give the child her full time now.

You may think this just couldn't happen to your child. Why not get the suggestions of an Equitable agent and make sure it won't?

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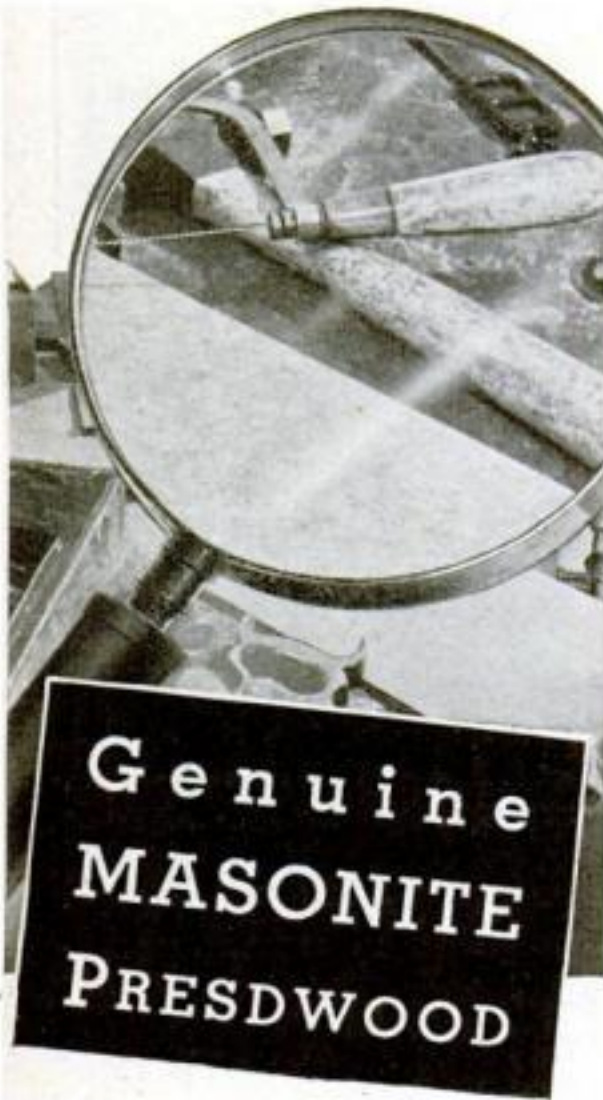
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Our BLUEPRINTS

Are Guideposts to Home Workshop Success

TO AID you in your home workshop, POPULAR SCIENCE MONTHLY offers blueprints with working drawings of a number of well-tested projects. The blueprints are 15 by 22 in. and are sold for 25 cents a single sheet (except in a few special cases). Order by number. The numbers are given in italic type and follow the titles. When two or more numbers follow one title, it means that there are two or more blueprints in the complete set. If the letter "R" follows a number, it indicates that the blueprint or set of blueprints is accompanied by photographically illustrated instructions which supplement the drawings. If you do not wish this supplement, omit the letter "R" from your order and deduct 25 cents from the price given. The instructions alone are sold for 25 cents each. Many other blueprints are available. Send a stamped and addressed envelope for a complete list.

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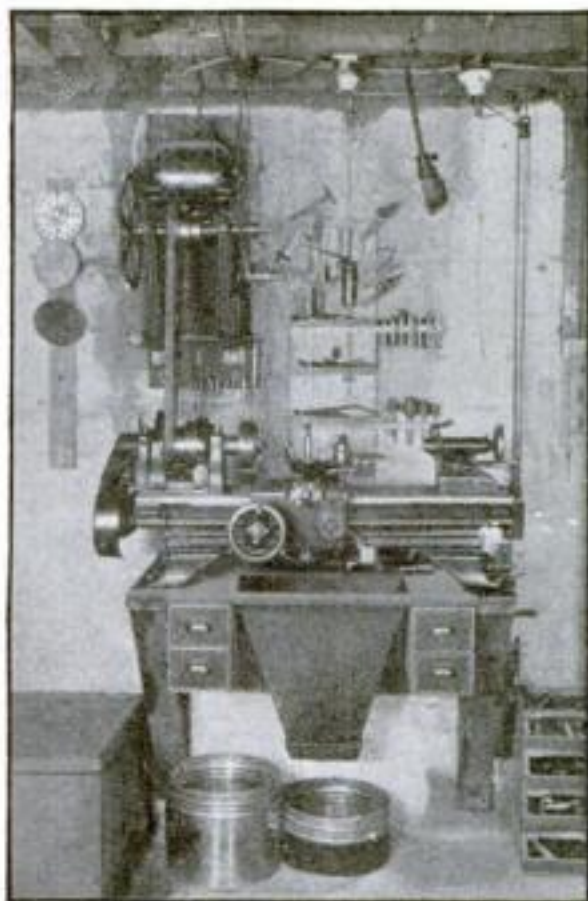
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SHIP MODEL in a BOTTLE



YOU can amaze your friends by building a beautiful little clipper ship model in an ordinary bottle. They will think you cut off the bottom of the bottle in order to get it in, but you can quickly show them that it must have been inserted through the neck. The trick is really a simple one. It is fully explained by Capt. E. Armitage McCann in our Blueprints Nos. 121-122, price 50 cents.



MAKING A BENCH LATHE HANDIER TO OPERATE

FOR convenience, flexibility, and economy in space, the method of setting up a bench lathe shown above has much to recommend it to the amateur machinist. In the first place, there is a chute in the bench through which the chips and turnings from the lathe are directed into cans on the floor. The small can is for metal chips, the large one for wood chips.

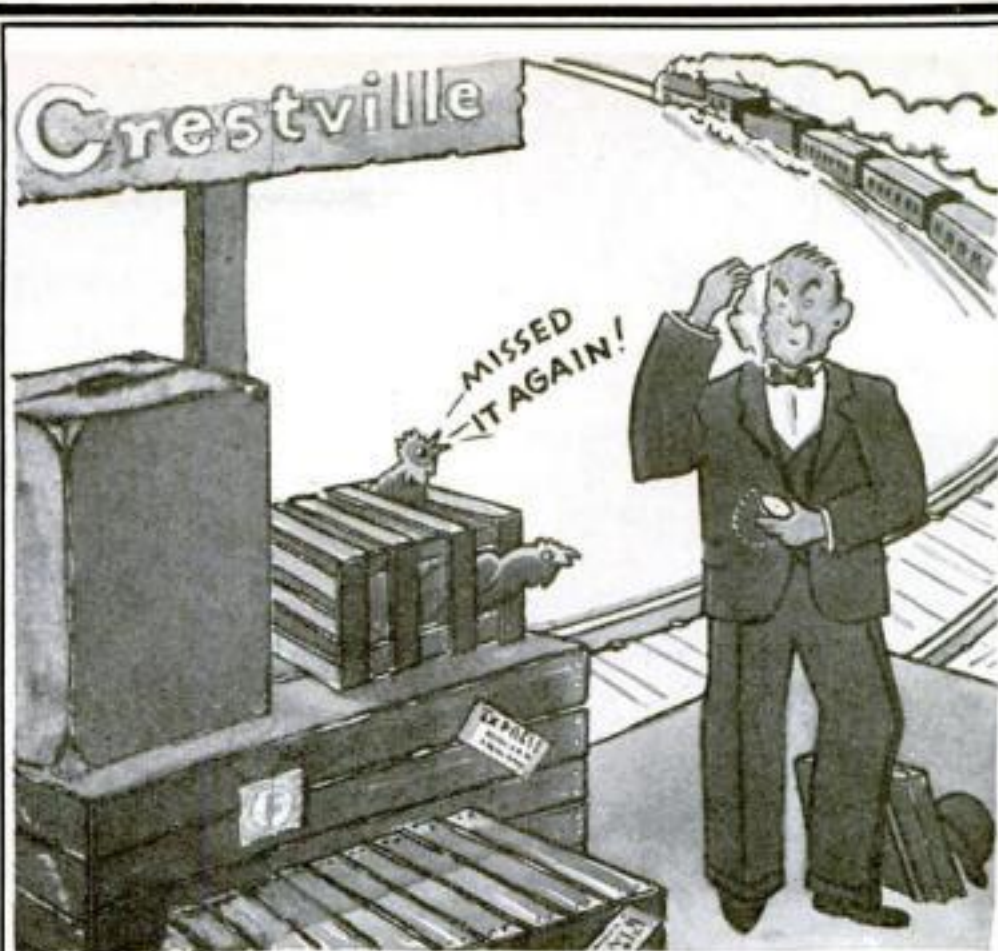
The motor, by having the brush holder loose in its sleeve so that it can move about $\frac{1}{4}$ in., is reversible. The lathe may be made to run in either direction merely by starting the cone pulley in the desired direction. This is very useful when cutting threads or removing chucks or faceplates. A close inspection will also reveal, directly in the center just above the tool post, a switch-control button that hangs from the pull switch on the ceiling.

The tool rack in the background is a convenience, and there are small drawers underneath the bench top for drills and other attachments. The light is another feature. It can be shifted to any desired position as it is on a flexible gooseneck held to the rafter with a clamp. The counterweight keeps the extra wire, which runs through pulleys, out of the way at all times.—DONALD R. DOREMUS.

DISKS OF EMERY PAPER GRIND FAUCET SEAT

SOMETIMES a compression faucet continues to leak even when a new washer is used. It then becomes necessary to grind the seat or to buy a new faucet. As it is often impossible to obtain an exact duplicate of the old one, both faucets in a washbowl may have to be replaced unless you are willing to have two different patterns.

The following is a cheap and easy solution. Remove the faucet stem and also the washer. Cut disks of coarse emery paper by hand to the size of the washer, punch them in the center, and place them, cutting side down, on the stem. The stem is then replaced and the handle turned back and forth until the grinding is accomplished. As the emery paper disks wear, they can be torn off one by one. Originally they should be stacked as thick as the washer.—KARL L. MARTIN.



"My watch pinions need Oilstoning"

IF the ticking pace of your watch falls behind only one tick in 10,000, it will lose a minute per week.

From five to seven pinions in your watch have jewel bearings, including that important member, the Balance Staff. Others, as you know, rest on metal bearings. Ticking pace accuracy every second, week after week, depends on these pinions being *oilstoned*. A Norton Pike Hard Arkansas oilstone file is used in all fine watch factories. No other will do.

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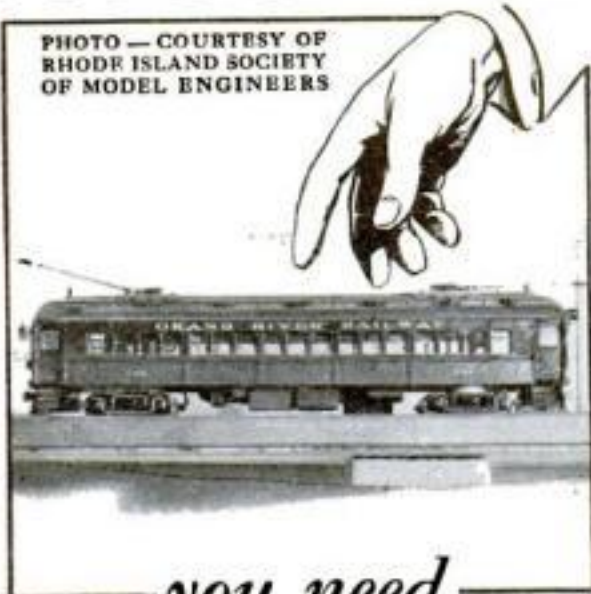
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When you're building MODELS

PHOTO — COURTESY OF
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—you need—
Nicholson Files

Fred Williams, who built this model of the Grand River Railway, says that he used Nicholson Files for 60% of the work. He adds that he used Nicholson Files because he found them best qualified for both the coarse filing and finishing work.

For all types of modeling, you need Nicholson Files. They are the most generally useful tools for woodworking as well as metal working. No home workshop is complete without them.

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Nicholson Files are exhibited in "The Home Workshop" at A Century of Progress, Chicago, Building 3, second floor.



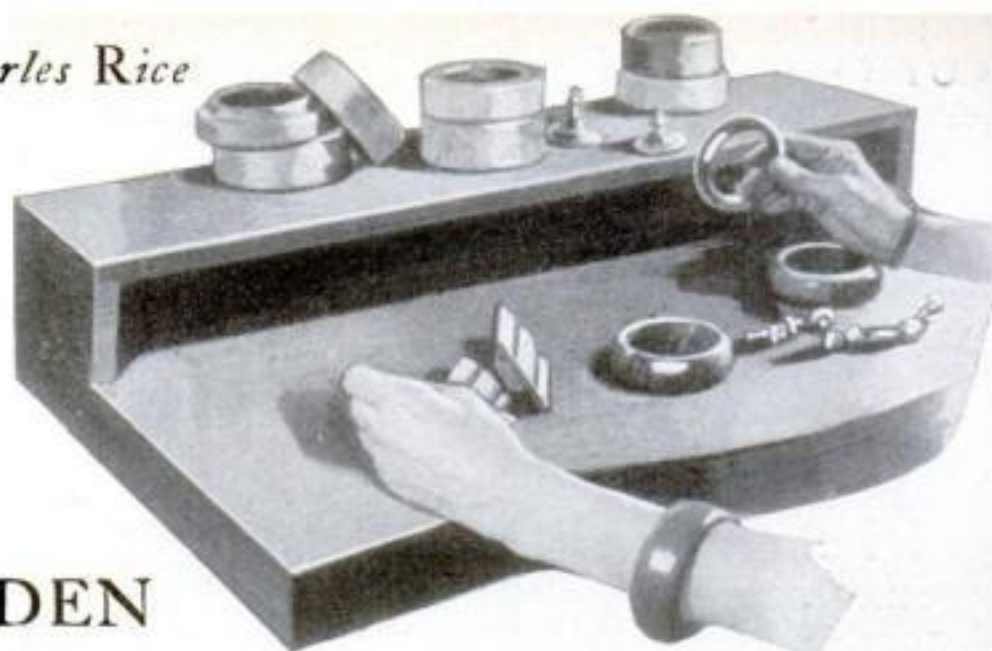
This anchor for a model yacht was filed from six inch screws with a Nicholson File.

Genuine
**NICHOLSON
FILES**



A FILE FOR EVERY PURPOSE

By Charles Rice



WOODEN

Costume Jewelry

TURNU ON AN EMERY GRINDER

WOODEN jewelry, which is much in demand for use with women's sport costumes, can be made by any home worker. Little material is required, the work is simple and interesting, and there are undoubtedly some possibilities for profit in it for those who wish to make the jewelry for sale.

It is not necessary to have a lathe. An ordinary tool grinder—or emery grinder, as it is commonly called—will serve the purpose almost as well; in fact, a lathe can be improvised from it quite easily as shown in the photographs below. In this case the grinding head is one with a 1/2-in. shaft threaded at both ends and carrying two emery wheels. At the time it was purchased, a sanding disk, threaded to fit the shaft, was also obtained for use as a faceplate. The tool rest was made from hardwood, with a bolt and wing nut to hold it in place on the wooden bed.

The faceplate was made by fastening a round disk of 3/4-in. hardwood to the sandpaper disk with screws. A hole was drilled exactly in the center of the sandpaper disk and continued through the wooden disk, and then was countersunk to suit a 2-in. flathead wood screw, which was inserted as a center.

Right: Wooden blank in place on mandrel ready to be turned on the outside. *Below:* Disk mounted on faceplate for roughing out and turning the hole



The wooden disk should be trued up by turning the edge and also facing the surface.

The stock is prepared by first sawing out a number of hardwood circles for bracelets. They need not have a diameter greater than 4 in. The stock should be selected for beauty and unusual configuration, and each piece should have a small hole drilled at the center. Such woods as Oregon myrtle, cocobolo, rosewood, and maple and walnut burls are most effective.

To make a bracelet, fasten one of the round pieces to the faceplate, being sure that the screw holds the stock tightly. Cut away enough wood to true up the outside, then turn out the inside carefully, almost through to the faceplate. (Save a small core at the center for later turning out an eardrop.) Sandpaper the inside surface and cut it away from the faceplate. The end of the core may now be turned into an eardrop.

A mandrel should be made for turning the outside of the bracelets. It may be made by fastening the end of a 5-in. length of softwood to the faceplate and turning it down to the proper size and taper to accommodate any variation in bracelet sizes. Place one of the blanks on the mandrel and test it for position by gaging with a chisel while slowly rotating the mandrel by hand. One or more bracelets may be turned depending on the width desired. Sandpaper the surface and polish with a handful of shavings.

A French polish is easily applied while the bracelet is still on the mandrel. Place a few drops of white shellac, thinned with alcohol, on a cloth and apply it slowly to the revolving object.

The eardrops are made from the unused cores that remain on the faceplate after the bracelet has been removed. They should be made round or button-shaped and polished while still on the faceplate. The metal ear clamps may be obtained by buying made-up earrings from the ten-cent store. Use liquid solder to attach the turning to the ear clamp.

Belt buckles, as well as coat and dress buttons, can be formed in much the same way. With the faceplate removed and a sandpaper disk attached to the grinder shaft, one can quickly work out many other designs from pieces of roughed-out stock.

TWISTED FLOWER STAND CUT FROM SOLID WOOD

THIS unusual wooden flower stand, which is certain to arouse curiosity wherever displayed, looks as if it had been twisted bodily a quarter of a turn by some giant. Actually the pedestal is shaped from a solid block 4 by 4 by 18 in.

Plane the sides of the block square, and see that the two ends also are exactly square as shown at A. Then taper the block to 2 in. square at one end, as at B. Now bore a 1-in. hole $1\frac{1}{2}$ in. from the top and a 2-in. hole $2\frac{1}{2}$ in. from the bottom and in the center of all four sides. Bore each hole only halfway through. Mark the four sides

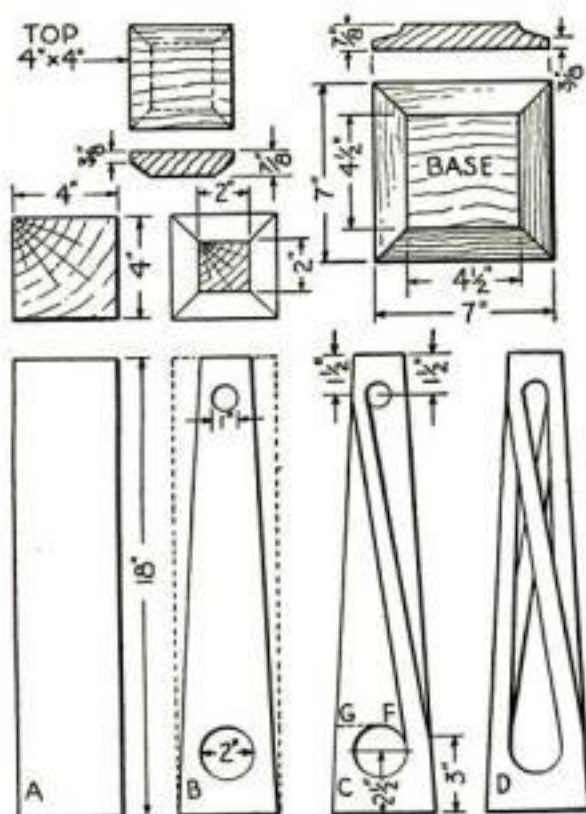
as at C and cut away the triangles based upon the dotted line GF. Some of the inside wood can be cut away with a compass saw, but the rest must be carved out with chisel and pen-knife to obtain the final shape, which is shown at D and in the photograph.

The top is $\frac{3}{8}$ by 4 by 4 in. with the bottom edges beveled back $\frac{3}{4}$ in. Dowel and glue the top on. The base is $\frac{3}{8}$ by 7 by 7 in., the edges being shaped as shown in the drawing. It is fastened to the body with screws.

The stand illustrated was made of cypress and stained a walnut color. It was then given three coats of shellac and rubbed down well between coats with fine sandpaper and steel wool.—WILLIAM HARVEST.



A giant might have twisted this stand



The four steps in laying out and carving the pedestal, and details of top and base blocks

PAPER CLIPS FASTEN ELECTRIC CORDS TO TOP OF BASEBOARD

THE ordinary long type of wire paper clips make neat fasteners to hold electric cords at the top of the baseboard when it is desired to run the cords along the side of a room. Simply snap the clip over the cord and push it down between the baseboard and the plaster.—ARTHUR L. FORD.

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Model comes both in handy pouch packages and in conventional tobacco tins. Some men prefer it one way—others like it the other way. But they agree on one point—that MODEL represents the best smoking value anywhere for 10 cents. There are many who declare it can't be beat, no matter what they pay. If you can recognize good tobacco quality, try MODEL and see how much 10 cents will buy.

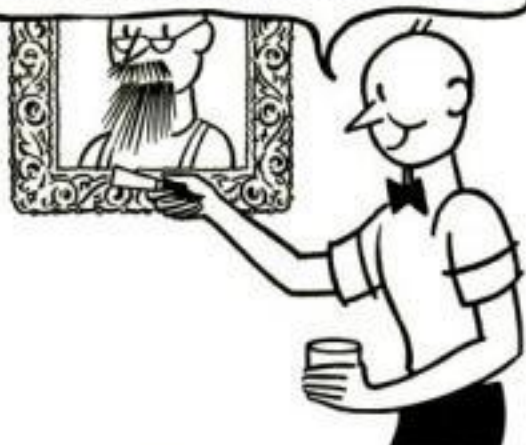
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BRILLIANT BIG ENLARGEMENTS

(Continued from page 78)



Autofocusing enlarger mounted horizontally for enlargements of greater size than usual

The developer is made up into stock solutions, which will keep well.

STOCK SOLUTION "A"

Potassium iodide.....80 grains
Sodium sulphite..... $\frac{1}{2}$ oz.
Water.....16 oz.

STOCK SOLUTION "B"

Sodium sulphite.....1 oz.
Silver nitrate (poison)...120 grains
Hypo crystals..... $2\frac{2}{3}$ oz.
Distilled water.....16 oz.

To mix stock solution "B," first dissolve the sodium sulphite in 5 oz. water. Dissolve the silver nitrate in 2 oz. water and then add this to the sodium sulphite solution. It will curdle, and the precipitate thus formed must be dissolved by stirring. Now dilute the solution to 14 oz. with water, add the hypo, and when the latter is dissolved add more water to make 16 oz.

Stock solution "A" is used full strength and need not be changed until solution "B" is used up. To use solution "B," take 1 oz. stock solution and 4 oz. water for each 5 oz. developer. To this is added, within five minutes of starting development, 4 grains of amidol for each 5 oz. of developer.

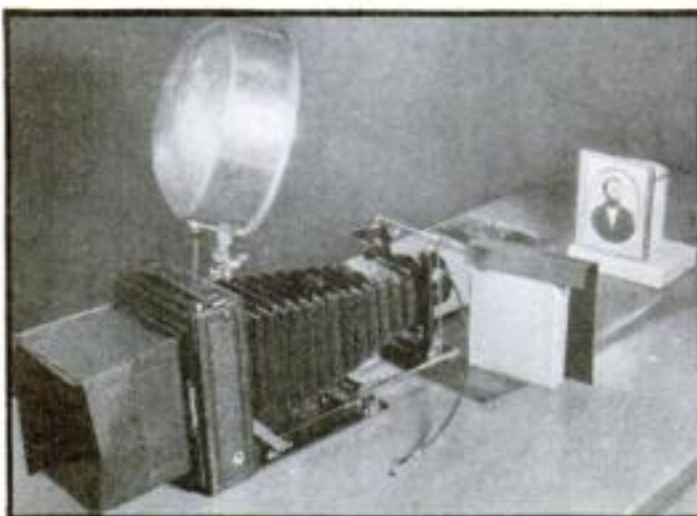
The actual development process is simple. After unrolling the film in the darkroom, immerse it in solution "A" for thirty seconds. Rinse it well with clear water and fasten it in the tank. Over the film pour the developer "B," diluted as directed above. Close the tank, and you may turn on the white light. Occasionally rock the tank during the development time, which will be from 45 min. to $1\frac{1}{2}$ hrs. at about 65 degrees F.

When the negative appears of the same density in looking through it from both front and back, it is sufficiently developed. After a brief rinse it may be placed in the regular acid hypo fixing bath, and will require more time than usual to clear up.



For moving the lens closer to the negative, the enlarger is screwed to a plywood strip

Do You Know How to Copy a Daguerreotype?



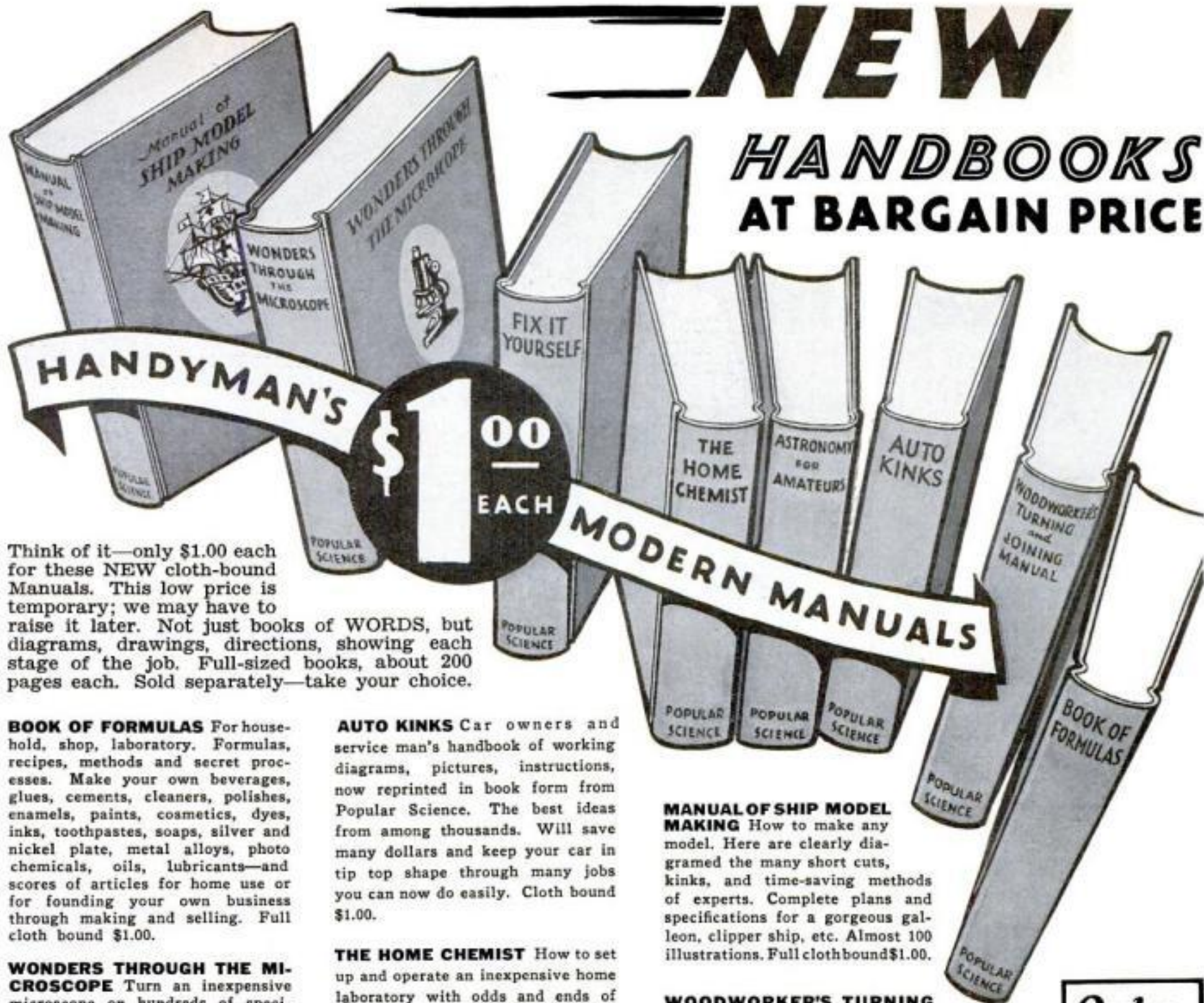
Daguerreotypes can be photographed by using the set-up shown at the left. Note the piece of black paper used to subdue the reflections

ALMOST every family has some cherished daguerreotype carefully preserved in its original plush frame. It may show grandfather when he was a young blade, or father when he was a baby, or grandma in her wedding gown. It is easy to make a photographic copy of such a picture if you go at it right. Just follow the illustration in setting up

the camera. The idea is to place the daguerreotype at such an angle that the highly polished silver surfaces which represent the dark areas of the picture will reflect no light and therefore look dark to the lens. A piece of black paper is placed near the camera lens as shown to accomplish this. It may be supported by a small box, a book, or other article.

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MODEL 33
BOLT-ACTION
SINGLE SHOT

Remington



\$2,000 IN CASH—TEN SILVER TROPHIES

(Continued from page 73)



A general view of the initial exhibition held by the Leatherstocking Homeworkshop Club in the First National Bank Building of Cooperstown, N. Y. It was viewed by 566 visitors.

given by the Millers Falls Company, are for the three clubs that have displayed the best civic spirit and have rendered the most benefit to their local communities. One of the distinguishing features of the Guild has been the civic work of the various clubs in making toys for needy children, building scenery for amateur plays, making and repairing equipment for schools and playgrounds, and cooperating with the Y. M. C. A., Boy Scouts, Girl Scouts, charitable organizations, and community recreation centers. To qualify for this division of the contest, the clubs will be required to make a statement, signed by the club officers, on a form which will be provided, together with such other proof as the Contest Committee may desire.

The grand sweepstake prize, Division 10, will be awarded to the club that wins the most points in the other divisions. For each first prize won by a club or one of its members, 5 points will be awarded; for each second prize, 4 points; for each third prize, 3 points; for each honorable mention, 2 points. In addition, 1 point will be added for each division in which a club is represented by an entry. If, for example, a club has one or more entries in each division from 1 to 9, its score will be increased by 9. To win this prize will immediately add \$200 to the lucky club's treasury, so it obviously will pay the clubs to enter as many divisions as possible, especially as the decision is likely to be a very close one.

All the other divisions of the contest—those numbered from 3 to 9—are for the individual members of clubs. Both the trophies and the cash awards will go to those who submit the winning entries in each classification and will become their property. Each prize won by a club member, however, will add points to his club's score for the grand sweepstake prize, as previously explained.

Since it has been found that woodworking is the predominant interest among all the clubs, most of the prizes will be awarded for excellence of design and perfection of craftsmanship in wood. Three awards will be given for furniture made exclusively with hand tools in Division 3, sponsored by E. C. Atkins and Company, and three prizes for furniture made mainly with power-driven tools in Division 4, sponsored by the Delta Manufacturing Co. Projects that are wholly or mainly made on the lathe will be grouped by themselves in Division 6, of which the Greenlee

Tool Co., Division of Greenlee Bros. & Co., is the sponsor. They may be lamps, candlesticks, bowls, trays, gavels, or similar articles that are almost exclusively wood-turning projects, or they may be pieces of furniture or objects of utility in which wood turning is the predominant operation, but not the only one used. In each case, however, the judges will base their decision on the appropriateness and excellence of the wood turning.

Similarly, any type of project involving veneering or inlaying, or both, may be submitted in Division 5, whether it is a small novelty such as a jewel box or a picture in wood veneers, or a large piece of veneered furniture. The prizes in this division will be provided by the Casein Manufacturing Company of America, Inc.

All other wooden novelties, all metal novelties, and all toys, whether of wood or metal, will be grouped in Division 7, sponsored by Henry Disston & Sons, Inc. The judges will give the greatest weight to the novelty and general appeal of the projects. In other words, the ingenuity and originality of the design will be of more importance in this classification than the perfection of the craftsmanship. This will give a chance for those club members to compete who happen to have good ideas for amusing and interesting toys and novelties but may not be able to work them out very well. It will not matter if the projects are somewhat crude, provided there is a really good idea back of them.

All models, whether of ships, railway locomotives or cars, stagecoaches, buildings, engines, or of any other type, will be entered in Division 8, sponsored by the Russia Cement Company. Here the craftsmanship will be of greater importance than the subject. Neat workmanship, accuracy in scale and detail, and beauty of finish will be the deciding factors.

Decorative metal work will be entered in Division 9, the prizes for which will be given by the Carborundum Company. It includes all types of sheet-metal projects in brass, copper, pewter, and other materials, as well as wrought-iron work. Anything that is made of metal and is primarily of an ornamental nature may be submitted in this division.

The Contest Committee is now formulating detailed rules and regulations for each classification. These will be published in the Guild Bulletin and (Continued on page 95)

\$2,000 IN CASH—TEN SILVER TROPHIES

(Continued from page 94)

sent to each club secretary, together with the required application blanks. No unnecessary red tape or restrictions will be included because it is the desire of the officers and directors of the Guild to have the clubs submit a great variety of the typical work they are doing. The reason so many divisions and prizes have been provided is to bring out projects that are genuinely representative of the everyday craftsmanship of club members.

The logical way for clubs to decide on what particular projects to enter in the contest is for them to make a selection of the best ones displayed at their own local exhibitions. To encourage a spirit of friendly competition among the members, POPULAR SCIENCE MONTHLY, as previously announced, will donate to each club a sterling silver medal, provided it has twenty or more members. This medal is to be awarded by the club, without restrictions and under its own rules, to the member who displays the best

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work at the local exhibition. The same project can then be entered in the national contest, along with a selection of the best work of other members.

Every club should make a point of seeing that at least one entry, if possible, is made in each of the classifications of the national contest, not only to make that contest thoroughly representative, but also to increase the club's score for the grand sweepstake prize. All correspondence relating to the contest should be addressed to the Guild Contest Committee, care of POPULAR SCIENCE MONTHLY, 381 Fourth Ave., New York.

WHAT CLUBS ARE DOING

The Peekskill Homeworkshop Club of Peekskill, N. Y., has a number of instructive craftwork programs planned for the fall. As a rule, the board of governors meets a few days prior to each regular meeting and formulates whatever club policies are to be voted on. This allows the business of the club to be transacted very quickly; in fact, only thirty minutes are allowed for business at the average meeting. The remainder of the evening is spent in listening to a talk on some subject of general interest. Among the subjects already covered are leather craft; glue, gluing, and clamps; abrasives; the use and sharpening of planes and chisels; pewter craft; rocks and (Continued on page 96)

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\$2,000 IN CASH—TEN SILVER TROPHIES

(Continued from page 95)

minerals; board measure, layout tools, and mechanical drawing; and model aircraft. The lecture and demonstration on model aircraft was given by Clifford Moser, a member of the club who has specialized in this work.

In addition, an industrial movie obtained through the National Y. M. C. A. is frequently presented. The movie films are obtained for the cost of transportation, amounting to less than \$1.50 a month, which is paid

Who Has the Most UNUSUAL Home Workshop?

PRACTICALLY every club in the Guild has been pleasantly surprised to discover among its members men who have unusual workshops. If secretaries will send photographs of some of the best of these shops to the Guild Editor, as many as possible will be published. Each photograph should show the owner of the shop at work in it.

for by occasionally offering the members a "dark horse." This is a tool the value of which is announced, but not its name.

For its "hall," the Peekskill Club has an old carpenter shop, the use of which is given free. Twelve or fifteen major hobbies are represented in the club so that good program material is available for months to come.

"We have added a library and a librarian to our official set-up," Louis Hof, the secretary, reports, "and already have a good start on many blueprints. Our members are turning in old plans of projects they have built, along with back issues of POPULAR SCIENCE MONTHLY, which are then clipped and the home workshop articles filed alphabetically for ready reference."

The first exhibition of the Leatherstocking Homeworkshop Club of Cooperstown, N. Y., was held in the First National Bank building. Furniture, models, examples of inlaying, metal work, tools and machines, jig-saw work, decorative metal work, sporting equipment, examples of gunsmithing, and a variety of other articles were exhibited. At the close of the show the register of visitors contained 566 names. The club has begun its community work by repairing old toys collected by Boy Scouts and Girl Scouts for distribution next Christmas to families that need them.

John O'Gorman, a member of the Wichita Falls Homeworkshop Club of Wichita Falls, Texas, has a trolley car for his shop. When the local traction company offered some of its old cars for sale, he bought one, converted it into a comfortable place to work, and installed an assortment of small machines and a large collection of hand tools. Woodworking is O'Gorman's hobby. He has made a piano case, dining-room chairs, a metal-bound chest for silver, and other advanced projects.

The Wichita Club recently witnessed a demonstration in wood carving by the Rev. C. A. Beesley, who was at one time a master carver in London, England. He showed how an amateur can do any ordinary type of carving with only five tools, although he himself owns 150. (Continued on page 97)

Quick Drying

61 FLOOR VARNISH

"61" makes carefree floors that are marproof, heelproof and waterproof! Requires no polishing. NOT slippery! At paint and hardware stores. Pratt & Lambert Inc., Buffalo, N. Y.

PRATT & LAMBERT PAINT AND VARNISH

MAKE MONEY building this 32" absolutely accurate 100% flying scale model.

STINSON RELIANT AIRLINER COSTS \$250 SELLS FROM \$15 UP

An unusual money-making opportunity and a fascinating hobby for men and boys. Build this Stinson Reliant Airliner at home and sell to stores and individuals at a big profit. \$2.50 kit makes a \$15 plane. Big demand for display and decorative purposes. Guaranteed to fly, easy to build, follow exact blueprints in the most complete kit you ever saw. Send \$2.50 today for Stinson kit. Other models at \$5.00, \$1.75, and \$2.00. Ask for FREE folder full of latest plane models.

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Blocks	Funnel Ventilators	Stock Anchors
Boxwood Natural	Cowl Pine	White metal
1/16" 3c	3/16" 2c	1 1/4" 25c
1/8" 3c	1/2" 2c	1 1/2" 30c
3/16" 3c	3/4" 2c	2" 35c
1/4" 4c	1 1/4" 2c	
5/16" 4c	1 1/2" 2c	
3/8" 4c	1 3/4" 2c	
1/2" 4c	2" 2c	
5/8" 4c		
3/4" 4c		
7/8" 4c		
1" 4c		
1 1/8" 4c		
1 1/4" 4c		
1 1/2" 4c		
1 3/4" 4c		
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9" 4c		
9 1/4" 4c		
9 1/2" 4c		
9 3/4" 4c		
10" 4c		

Propellers: Right or left 1/4" 2c, 1/2" 2c, 3/4" 2c, 1" 2c, 1 1/4" 2c, 1 1/2" 2c, 1 3/4" 2c, 2" 2c.

Stockless: 1 1/8" 20c, 1 1/4" 25c, 1 1/2" 30c, 1 3/4" 35c, 2" 40c.

10c extra for attaching shackles. Add 10% postage to all orders over \$1.50—minimum order 25c—10c postage.

Selley Mfg. Co. Inc., 1375 Gates Ave., Dept. 910 Brooklyn, N. Y.

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ABSOLUTELY FREE BB MAGIC

The NEW BENJAMIN 25 SHOT REPEATER with BOLT ACTION—HAMMER PUMP—HAIR TRIGGER—PRICE \$7.50 is the most sensational improvement in air gun history. Send name—address—age—kind of gun you now have—if any—for your copy of BB MAGIC—FREE—A real gun manual based on U. S. Army regulations, etc. Also send for details of 1934 BENJAMIN SUPER SINGLE SHOT—BREECH LOADER—BOLT ACTION—HAMMER PUMP—HAIR TRIGGER—PRICE \$5.50 and our SPECIAL INTRODUCTORY OFFER. WRITE NOW.

BENJAMIN AIR RIFLE CO., 693 N. Broadway, St. Louis, Mo., U. S. A.

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Keep all your tools in service longer—save equipment repairs and replacements—by using the oil that cleans and prevents rust as it lubricates. 3-in-One is specially blended for this triple job. All good stores have 3-in-One.

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SHIP MODELS

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The quick and easy road to ship modeling is to get one of our accurate scale construction sets. With them you can concentrate on the interesting part of the model. Similar sets for models of Flying Cloud, Destroyer Preston, Constitution, U. S. S. Texas, Whaler Wanderer and many others. Also semi-finished hulls and all sorts of materials and fittings such as blocks, deadeyes, anchors, steering wheels, guns, lifeboats, etc. Large 64-page photographically illustrated booklet, describing the above sent postpaid upon receipt of 15c (refund). Many persons on receiving this booklet, have discovered how simple and enjoyable is ship model making. Be sure to get your booklet before starting your model.

Model Ship Supply Co., Dept. P, Mineola, N. Y.

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FREE!! ACE RADIO LABORATORIES Dept. S-10 1619 Broadway New York City



DRILL \$17.45

As Shown

A husky machine, 9" swing x 1-1/2" chuck used vertically or horizontally, for drilling, grinding, sawing, polishing and mending wood, metal etc. Powerful 110V. A.C. Motor. Guaranteed. F.O.B.

SOUTH BEND DRILL CO. 228 Dixie Way S., South Bend, Ind.

\$2,000 IN CASH—TEN SILVER TROPHIES

(Continued from page 96)

During the summer the members of this club added to the stock of toys they are making for Christmas distribution to needy families.

The Queen City Homecraft Club of Elmira, N. Y., did not allow its activities to lapse during the summer. A meeting was held once a month and an exhibition was given in the window of a large hardware store. Delos A. Smith exhibited a model of the galleon *Revenge*; Daniel H. Plummer, a model of the *Sovereign of the Seas*; Robert Barr, a 5-ft. model yacht; Donald L. Finch, a painting "The Pennon of St. George," which shows the galleon *Revenge* in action against the Spanish Armada; Glen W. Updyke, a lamp ornamented with a miniature ship's steering wheel; C. E. Johnston, a large divided serving tray also made in the shape of a steering wheel; Donald Stow, book ends in the form of small radio sets; Milton A. Knapp, a desk and chair; Clarence E. Wright, a footstool and end table; J. O. Jones, a table; A. G. Eiband, an inlaid game board; Preston H. Straley, a trinket chest; Frank Hoskins, a floor lamp; and E. L. Burton, a sewing table.

The Antioch Homeworkshop Club of Antioch, Calif., suggests the construction of a bookcase to hold the club library as an excellent group project for other clubs. In its own case, the club collected money for the materials, and one of the members built the bookcase. The club now meets regularly in the recently enlarged workshop of P. J. Whitney, one of the members.

In spite of the difficulty of organizing any new club and getting it started during the summer season, two clubs have applied for charters since those listed in the last issue of POPULAR SCIENCE MONTHLY. They are the Indian River Homeworkshop Club of Eau Gallie, Fla., and the Pocono's Homeworkshop Club of Stroudsburg, Pa. All new clubs will be announced in these columns as soon as possible after their organization. POPULAR SCIENCE MONTHLY publishes all official news of Guild headquarters and the various local clubs.

FREE BULLETIN TELLS HOW TO START CLUB

THE best method of starting a home workshop club is outlined step by step in a free bulletin you can have by filling out the coupon below. Send for it at once.

To amateur craftsmen the Guild offers the opportunity of enjoying real coöperation and companionship in their hobby. It is the first time this opportunity has existed in the home workshop field. The purpose of the Guild is solely to promote handicraft of all types. The officers and directors of the Guild are giving their time without pay, and the movement is entirely noncommercial. All the services, resources, and prestige of the Guild are placed freely at the disposal of the local clubs.

National Homeworkshop Guild
c/o Popular Science Monthly
381 Fourth Avenue, New York, N. Y.

I am interested in the home workshop club idea and wish to know what the National Homeworkshop Guild will do for me. Please send me this information in the large self-addressed and stamped envelope I am inclosing.

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HOME OWNERS:— This was written for you and is sent



DO your own simple home, auto and motorboat repairing and be independent of outside repair men. You will avoid delays, save much money, and have the satisfaction of knowing that the work is well done.

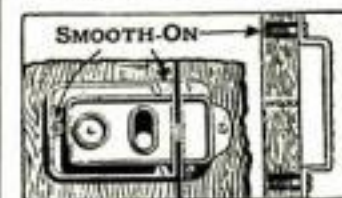


Stopping boiler leaks

The booklet contains clear diagrams and directions for correct procedure for hundreds of common jobs, and enables any home worker to get dependable results, easily, on any of the following:

Stopping leaks in pipes, heaters, boilers, tanks, radiators, air ducts, smoke pipes, pails, etc., at connections, seams, cracks, rivets or holes.

Tightening or anchoring loose hinges, locks, handles, screws, bolts, nuts, bases, stems, tops, casters, etc.



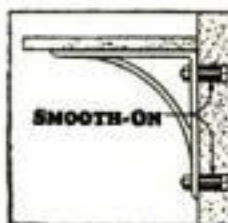
Tightening loose locks

Making waterproof joints at skylights, roof cracks and flashing.

Making wet cellars dry from the inside, making concrete floors hard, water and oil proof, and non-dusting, making masonry walls waterproof.

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Smooth-On has been widely used in industrial work for over 35 years and its use is standard practice by power plant engineers and repair men.

Get the booklet by mailing the coupon and buy Smooth-On No. 1 in 7 oz., 1 lb. or 5 lb. can from your hardware store or if necessary from us.



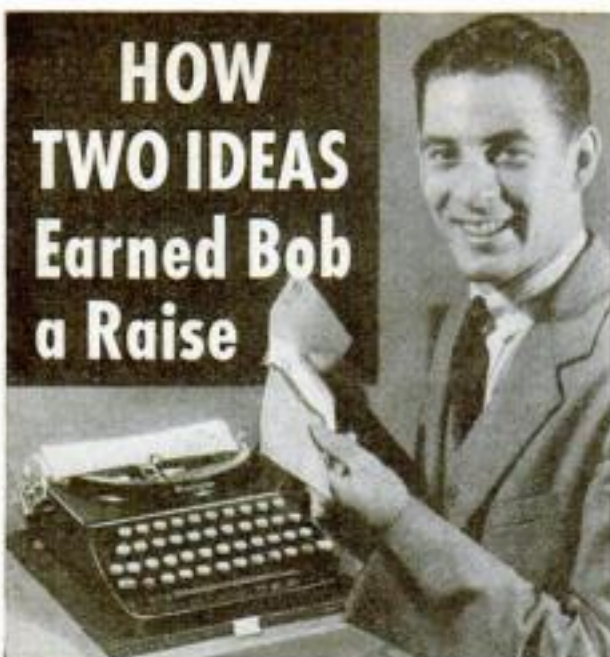
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HOW TWO IDEAS Earned Bob a Raise

BOB is just like anybody else . . . but he has two important ideas. The first is to keep his eyes open for ways to save his company money, to make suggestions for improvements. His second idea is to put those suggestions down in neat, easy-to-read black and white with the aid of a portable typewriter . . . so that they always get attention. The other day Bob got a raise.

Your boss is looking for men with ideas too. Are you getting credit for yours? A Remington Portable typewriter at home will help organize your thinking . . . help your ideas get attention. Get started now . . . mail the coupon today.

NEW REMINGTON PORTABLE ONLY 10¢ A DAY

Above model, complete with carrying case . . . standard keyboard . . . most big machine features . . . only 10¢ a day. Practical model writing capital letters only, just \$17.95 cash. Mail coupon for special offer.

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Only POSTAL LIFE of NEW YORK gives you an insurance value like this, for Postal sells direct and has NO AGENTS. That is why Postal's low premium of only \$1 a month buys \$1,221 of insurance at age 20; \$1,086 at age 25; \$948 at age 30; \$813 at age 35, etc.; all ages, 18 to 50, men and women. Send coupon to find out amount at your age.

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Casting Lead Toys

Get this complete outfit. Moulds for three different figures. Full equipment for casting. Paints for coloring. Make all the toys you want. Earn handsome profits selling them. Ask dealer for JUNIOR CASTER, or send \$2.50 money order and outfit will be shipped (postpaid in U. S.). State choice of U. S. Soldiers, Wild West Cowboys, U. S. Machine Gunners. Large illustrated Casting Book sent FREE on request.

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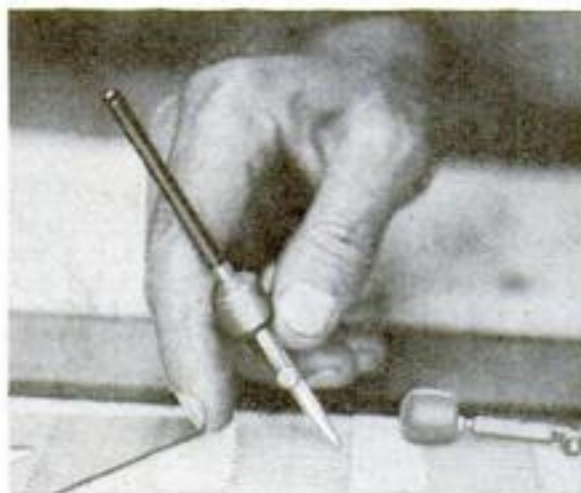
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FREE—24 PAGE BOOK

RUBBER BALL IMPROVES SMALL RULING PEN

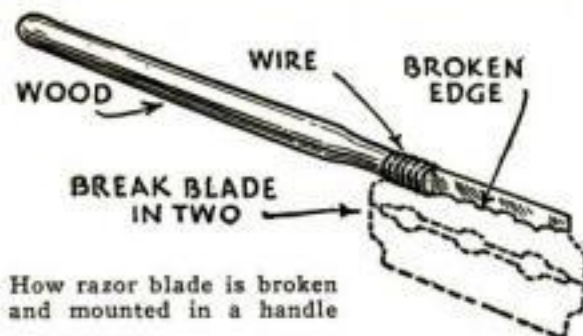


A small ruling pen will not cramp the fingers when fitted with this rubber-ball grip

EVERY draftsman knows how tiresome it is to use a small ruling pen for any length of time on close work. The strain on the fingers can be relieved, however, by slipping a small rubber ball over the handle of the pen as shown above. The ball is of the kind used in faucets of the fuller type and can be obtained at plumbing shops and large hardware stores. A piece may be cut off one side to keep the pen from rolling when laid down. The ball is not in the way when cleaning, filling, or adjusting the nibs, and it can easily be pulled off if the pen has to be put away in an instrument case.—W. F. B.

TINY SAW FORMED FROM BROKEN RAZOR BLADE

WHEN making models of ships or airplanes, it is often necessary to cut very small slots for fitting pieces together or to saw out pieces for which an ordinary saw would be too coarse. To make a saw suitable for this work, obtain a used razor blade of the type shown, clamp it in a small vise, and break away half of the blade as indicated by the



How razor blade is broken and mounted in a handle

dotted lines—that is, through the central slotted part. Use pliers to make this lengthwise break. Then break off very small pieces until the blade is the desired size and shape. The nature of the steel in these blades is such that by gripping as small an area as possible in the jaws of a pair of pliers, the pieces broken out will leave a series of sharp points. These serve as teeth for the saw.

Make a wood handle and saw a slot in it to receive the blade. The slot may be sawed by holding the newly made blade with pliers. Then wrap with fine wire to hold the blade in place.—JOHN C. ZIMBECK.

KEEPING CHEMICALS DRY

CHEMICALS that have a strong affinity for water and are usually difficult to keep in a dry state may be preserved by storing them in wide-mouthed bottles. Tamp a wad of cotton into the bottle so as to fill the neck, and then pour in a little melted paraffin. This gives a seal that is more secure than dipping the stoppered bottles in paraffin because there is no cork to loosen accidentally from shock or handling.—K. E. N.

Be a PHOTOGRAPHER!

Complete equipment for taking, developing and printing real photographs now costs only \$2.00.

It's Fun! • It's Easy!

Each picture costs only a few cents.

Photo-Kit is not a toy. All materials are just like those used by professional photographers. The Norton Camera takes clear, perfect photographs. Here's a list of the material Photo-Kit contains—



Norton Camera (with genuine Eastman lens, and precision-movement shutter) • Printing frame • Eastman film (specially made for Norton Camera) • Durez Developer tray • printing mask • 2 bottles of developer powder • Measuring glass • Box of fixing powder • Glass stirring rod • Durez fixing bath tray • Photographic paper • Eight-page instruction book • Album — for the pictures you have taken.

Get Photo-Kit at leading stores or send \$2.00, money order or check, to Dept. P-2, Cook Specialties, Inc., 35 W. 35th Street, New York City and we'll pay postage. Or we'll ship C. O. D. and you pay postman \$2.00 plus few cents carrying charges.

Crosman SILENT .22 Rifle

NO CLEANING Grooves inside barrel make the Crosman a real rifle with all the half-splitting accuracy this term implies. Shoots bullet same size as .22 powder rifle, but silently, powerfully, with no recoil, using the terrific force of compressed air—same force U. S. Navy uses to drive 2000 lb. torpedoes. Marvelous for target, small game. Single and 20 shot repeater models. No license required.

LOW COST AMMUNITION

ADJUSTABLE POWER

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FREE booklet containing important target and game shooting facts. Also free Crosman Catalog— or ask your dealer.

Crosman Arms Co., 411 St. Paul St., Rochester, N. Y.

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Remarkable vest pocket folding Camera, fine High Powered Lens, excellent view finder, takes time and instantaneous snapshots. A precision instrument throughout, produces pictures that amaze you. Can use tripod, comes with 5 films. Compares favorably with Camera costing many times more.

FREE! No dark room developing outfit with every Camera, printing frame and paper, fixing and developing powder, with simple directions a child can understand. Camera and complete outfit shipped prepaid \$1.25 (C.O.D. 20c extra).

Philmore Distributing Co., 1123 Broadway, Dept. "P", N. Y. City.

NYOIL

A MOST HIGHLY REFINED OIL

For fishing tackle, firearms, and household appliances, prevents rust. A perfect furniture polish, never gums, is odorless, stainless.

A handy can, 35c, postpaid if dealer cannot supply.

Wm. F. Nye Inc. Dept. S, New Bedford, Mass.

18" SHIP MODELS

Kit includes all materials for building hull, rigging, fittings also clear postpaid \$1.50

full-sized drawings for your choice Flying Cloud, Constitution or Spanish Galleon. Order now. Catalog 16c.

ROY HANCOCK

Build a model like this. 323 S. Douglas Ave., Portsmouth, Va.

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POPULAR SCIENCE MONTHLY

Don't be BALD!

GLOVER'S Mange Medicine is world-famous for its value in warding off Baldness, Dandruff, excessive Falling Hair and Itching Scalp.

Get Glover's Imperial Mange Medicine and Glover's Medicated Soap for the shampoo today, or have your Barber or Hairdresser give you the GLOVER SCIEN-TIFIC TREATMENT.

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Free! NEW DOG BOOK



GLOVER'S new Dog Book is the most complete and instructive Manual on Care, Training, Feeding, etc., ever produced. Contains many interesting illustrations. Write for a copy today.

Your dog is most susceptible to the more dangerous diseases when he is run down. If he lacks appetite, vigor and is listless, give him

GLOVER'S CONDITION PILLS They stimulate appetite; tone up the system and aid in giving the animal new life and pep. Splendid, too, after fever and in between worming periods. Insist on GLOVER'S—the standard for over 60 years. Safe and sure. Sold everywhere

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New 9" x 3' South Bend Lathe

This new 91/2" swing by 3' bed "WORKSHOP" LATHE is a Back-Geared Screw Cutting Metal Working Lathe; takes 18" between centers. Can also be used for working wood, compositions, etc. Has automatic longitudinal feed, graduated compound rest, 3/4" hollow spindle. Operates from lamp socket for 2 cents per hour. Cuts screw threads 4 to 40 per inch. Price with reversing motor, reversing switch and belt, \$94. Write for descriptive Circular No. 5-W. Sent postpaid.

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SOUTH BEND LATHE WORKS
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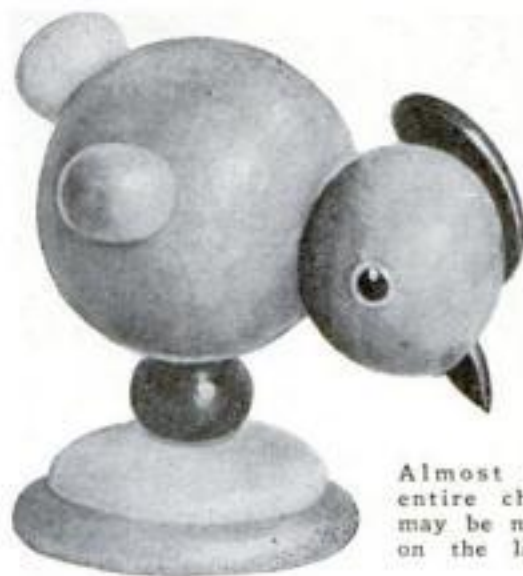
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COMICAL CHICK TURNED FROM BLOCK OF WOOD

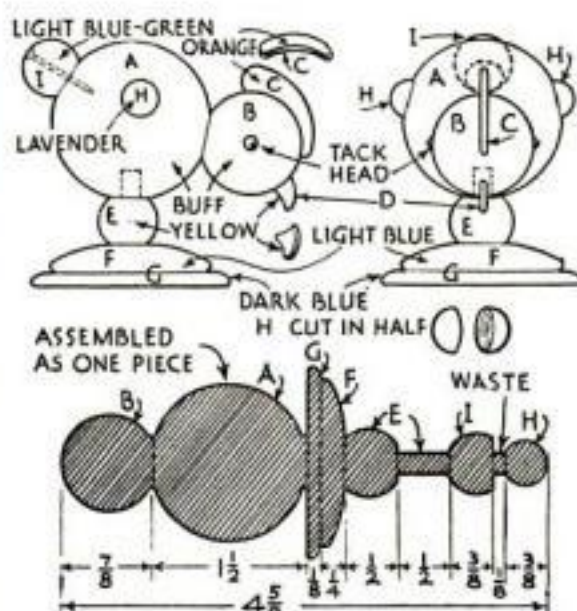


Almost the entire chick may be made on the lathe

THIS odd little chick may be made very easily and quickly on a wood-turning lathe. It will serve either as a toy or as an amusing ornament.

All of the parts except C and D may be turned from one piece of white pine 2 by 2 by 5 in. It is suggested that the parts be left together as one piece until all are fully shaped, after which the body and head (A and B) and the base (E, F, and G) are each treated as a single section and are assembled by boring a hole in the side of the body to fit the small end of E. If E is fitted tightly into A, there will be no need to use glue. The tail I and the two wings H may be assembled with brads and a little glue. H, of course, must be sawed in two. Parts C and D are carved from very thin wood and glued in place.

When the parts are all assembled, the surface should be gone over with sandpaper and any scratches, holes, or rough places filled with plastic wood composition or other hard-drying filler suitable for use under lacquer, if a lacquer finish is to be given the piece. A color scheme that has proved satisfactory is the one indicated in the drawing. A piece of felt may be glued to the underside of the base as a finishing touch.—F. CLARKE HUGHES,



Side and front views of the assembled chick, and how the parts are made in a single piece

CEMENT RUBS VARNISH SMOOTH

WHEN powdered pumice stone is not at hand for rubbing down varnish or shellac, try ordinary Portland cement with light machine oil or any oil that happens to be on hand. It will cut faster than pumice and oil or pumice and water, so watch your corners carefully. Apply it with a felt pad exactly like pumice and afterwards clean off every trace that remains.—L. W. H.

ENJOYS HIS PIPE AS NEVER BEFORE

San Diego Pipe Smoker Looks Forward to Many Happy Days

Only experienced pipe smokers learn to know the fine points of good pipe tobacco. Young men, new at pipe smoking, may save themselves the search (often a long search) for the right tobacco if they will heed the advice of those who know.

District Attorney's Office
San Diego, California
January 27, 1934

Larus & Bro. Co., Inc.
Manufacturers of Tobacco
Richmond, Virginia.

Gentlemen:

I have been a pipe-smoker for quite a number of years, twenty years to be exact, and have tried every tobacco known to me. I became so confused after many years of experimenting that I gave up pipe-smoking, but somehow I had a longing to resume and I was attracted to the advertisement and lured into sending you my thin dime and address which was promptly answered, and I very quickly smoked away the two packages you so kindly sent me.

The tobacco has a very fine aroma and I must say that I have enjoyed my pipe as I never had before. I have since replenished my stock with a half dozen cans of "Edgeworth Ready-Rubbed" and will now dig up some of my old pipe-friends, after cleaning the crust, and look forward to many happy days back in my mountain retreat, on Saturdays and Sundays.

Thanking you, and best wishes for your warranted success, I am,

Sincerely yours,
Lathrop H. Collins

Mr. Collins writes that he is going to "dig up" some of his old pipe friends. Note that phrase "pipe-friends." Pipe smoking is the friendliest way to use tobacco.

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ARC FURNACE INCASED IN TWO FLOWERPOTS

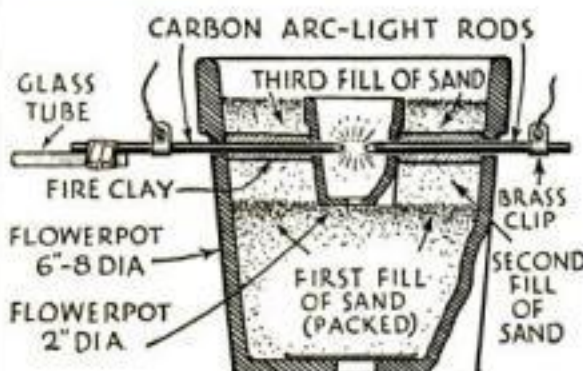


A SMALL electric arc furnace for experimental purposes can be made from two flowerpots, one 2 in. in diameter and the other either 6 or 8 in. Drill two holes opposite each other just below the lip of the smaller pot. (An ordinary steel drill will do this.) Make them large enough to receive carbon arc-light rods.

Cover the hole in the bottom of the large pot and fill with sand until the top of the small one, when set firmly on the sand, is about 1 in. below the top of the large one. Now drill a hole in the large pot at the same level of those in the small one. Push a rod through the three holes and mark the point of contact on the other side of the large pot. Be sure that the rod is level and the small pot is properly centered. Drill the second hole in the large pot and push the rod through it. Now pour sand around the small pot nearly to the level of the rod. Settle this by pouring a little water on it. Pack fire clay around the rod in the spaces between the two pots, being careful to get it close to both walls. This keeps the sand from jamming the carbons, which must slide easily. Pour sand even with the top of the small flowerpot and settle it with water. Withdraw the rod and set the furnace aside to dry. Lids may be made from flowerpot saucers.

Prepare the carbons by clamping a strip of brass or copper around each to furnish a good electrical contact. Tape a piece of glass tubing to one rod for adjustment as illustrated. The other rod should be held rigid while operating. The necessary resistance can be made by putting a teaspoonful of soda in a gallon of water. My furnace draws current through a 15-ampere fuse, which is safe for ordinary house wiring. To start, touch the carbons together.

Dark goggles *must* be used. Do not touch the carbons with the bare hands. Do not use a resistance of the type described when it is hot enough to boil.



Small arc furnace cut away to show how the space between the pots is filled with sand

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WATER-LINE MODEL OF AMERICA'S CUP YACHT

(Continued from page 71)

List of Materials

BALSA WOOD

No. of Pieces	T.	W.	L.	For
1	3/8	1 1/4	7 1/2	Hull A
1	3/8	1 1/4	4 3/8	Hull B
6	1/32	3/16	3/16	Hatches H
1	3/8	3/16	1/2	Boat G

MISCELLANEOUS

1 wood dowel, 1/8 in. round by 9 in. for mast C.

1 wood dowel, 1/16 in. round by 4 1/2 in. for boom D.

2 pc. split bamboo 1/64 by 1/64 by 6 3/4 in. for grab rails GR. and 2 pc. 1/64 by 1/64 by 1 1/2 in. for grab rails FR.

9 brass escutcheon pins.

8 smallest size pad-eyes. (These are obtainable from ship model supply dealers, but escutcheon pins may be used by leaving their heads slightly raised until all the rigging has been fastened, and then driving them in.)

1 thin needle 1 in. long for K.

1 pc. stiff thin wire 1/2 in. long for J.

1 pc. 1 3/4 in. long for sail X, and 1 pc. 2 1/4 in. long for sail Y.

1 pc. hardwood about 3/8 by 5 by 8 in. for base.

Glossy white, copper brown, and sea green paints. Mix brown and white to get light buff color for deck.

Cement or glue; sandpaper.

Paper for sails and thread for rigging.

F. One of these pins serves as steering wheel, and its head should be bent before it is inserted. Two more serve as binnacles and, together with the wheel, should be inserted only part way. The remainder, serving as winches, should be driven into the hull until the heads touch the deck. If the pins are longer than the depth of the hull in some places, cut off all but a short piece of the pin below the head, drill holes with a No. 70 drill, and fasten the heads of the pins into the holes with a drop of glue. Insert the eight pad-eyes E, following the same procedure in case they are too long. Insert the wire traveler J, which is shaped like a flattened and inverted U.

Make the mast by tapering C so that it is 1/16 in. round at the top and 1/8 by 1/16 in. oval at the bottom. Locate the various points that will require drilling for the spreaders and the rigging, and make holes with a No. 70 drill. Insert the split bamboo spreaders. Fasten the boom D to C with glue and thread for reinforcement. Paint the unit thus made a glossy white. Drill a hole upwards into the base of the mast and insert a pin, with head removed, part way. Step the mast into A, using this pin and a drop of glue for support. Rig the mast with cotton thread, following the diagram.

Cut the sails from medium weight paper. In gluing over the short flap of each jib, fold in a piece of thin wire. In gluing over the long flaps, fold in a piece of thread about 10 in. long, allowing at least 2 in. to hang over each side. With these ends, fasten the jibs to the mast and to their respective pad-eyes. Fasten the mainsail to C and D by tying short threads passed through the edge of the sail at about 1-in. intervals. If the sail has been cut accurately, it should bulge slightly as if bent to the wind.

The model should be mounted on a small wooden base before the rigging is carried any further. A piece of hardwood about 3/8 by 5 by 8 in. will serve very well. This should be enameled a sea green to simulate the appearance of smooth water. Glue back B to A, and then glue (Continued on page 102)

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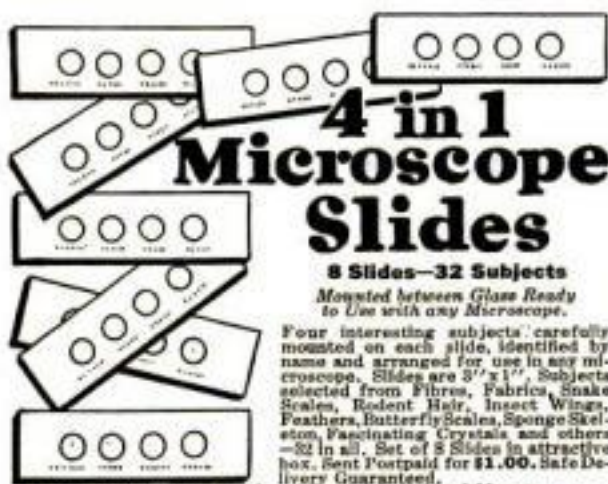
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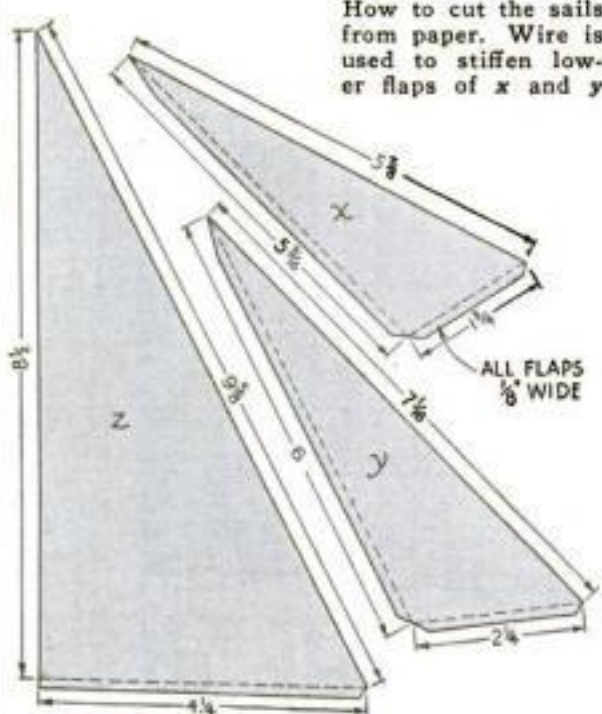
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WATER-LINE MODEL OF AMERICA'S CUP YACHT

(Continued from page 101)



How to cut the sails from paper. Wire is used to stiffen lower flaps of x and y

the hull to the base as shown in the photos. You will notice that the jibs and mainsail will tend to drop in the same direction as the list of the hull. Twist the short sides of the jibs to slight curves, which will be held in shape by the wires previously inserted; and from the free corners of each, run threads to the pad-eyes as shown in the side elevation.

Thread the needle K and tie it to end of boom D. Insert the point of the needle into the hull at the traveler. The angle should be such that it will hold the boom over to the side that has the list, about 1/2 in. from the center line of the hull. Paint the needle and the traveler white. Add the forestay and backstays by fastening them first to the mast and then bringing them down to the pad-eyes in the hull.

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EQUIPPING MICROSCOPE FOR POLARIZED LIGHT

(Continued from page 70)

piece with the same or longer tube may be used. Screw the lens in place, and the analyzer is complete.

The revolving stage is easily made if the directions given on the sketch are adhered to.

EITHER an ordinary microscope lamp with ground-glass front or daylight is used in the operation of the apparatus. The assembled instrument is set up as shown, and the light is allowed to fall on the polarizer, which replaces the microscope mirror. The microscope is focused in the ordinary way, but it will now be observed when the eyepiece is revolved that there are certain positions in which this revolution causes a dark field. The degree to which the field darkens is a test of the efficiency of the apparatus. The darker the field, the better the instrument.

The variety of slides which may be prepared for observation in polarized light is very large. For the amateur a great number of crystallizations, minerals, and organic substances are available. Perhaps the best and most spectacular slide to start with is a thin strip of mica, or several very thin strips of this mineral placed one on top of the other. When this slide is placed in the revolving stage, and the eyepiece and stage are then revolved, a beautiful series of color effects will be observed. Each color passes into its complementary color as the eyepiece is revolved through 90 deg. The best results are obtained by removing the top lens of the condenser and using a 4X eyepiece with a 4X or 10X objective. However, the instrument works very well without a condenser system if one is not available.

Another slide that is effective and easily prepared is a small piece of rock asbestos placed on the slide with the grain lengthwise. This gives beautiful parallel rods of delicate color tints. Crystallizations of sugar, copper sulphate, or aspirin make excellent slides. Crystallizations may be prepared in the ordinary way and mounted in Canada balsam.

ORGANIC substances that polarize well are thin sections of horn, fish scales, feather quills, the lenses of fish eyes, and sections of animal bladder.

With some substances, polarized light gives a series of dark rings and crosses. A little grated raw potato shows this effect very well. The large starch cells of the potato are easily discernible under fairly low power, and in each cell, with the aid of the polarizer, will be observed a dark cross which rotates as the eyepiece is revolved.

Polarized light has numerous applications in the industrial arts. It is used by the optician to detect strains in optical glass and in mounted lenses. The jeweler uses it to detect spurious imitations of the semiprecious stones. The chemist puts it to use in determining the concentration of sugar solutions and the identification of some of the sugar groups. It is used in the textile industry for the identification of the various fibers of wool, silk, cotton, or linen, each of these materials having its characteristic colors when examined in the light.

Perhaps the most interesting use of polarized light is its employment by the biologist in the examination of cell and tissue structure, particularly of muscle tissue. Here advantage is taken of the fact that with the aid of polarized light, materials which are normally transparent to ordinary light can be examined in detail, the details of the layer or fiber structure of the material being clearly defined in color. The light is used, too, extensively by the geologist and metallurgist.



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RUNS UNIQUE BUSINESS FROM FARM WORKSHOP

NEURITIS for three years made John L. Barker a helpless cripple, and forced the middle-aged Marysville, O. farmer to turn from his land to his workshop for a means of subsistence.



Born and reared on a 125-acre farm in Union County, Mr. Barker suffered a severe attack of neuritis at thirty. So helpless that he could not put on his own clothes, he was compelled as he slowly recovered to find a new way of making a living for his wife and children.

That was 18 years ago. Now Mr. Barker is becoming nationally known as a maker of hand-made, high grade casting and fly rods for fishermen. Although he has fully recovered from his illness, farming is only incidental in his new life.

Success came slowly. Mr. Barker started with a good store of determination and a knack for wood-turning. He began to repair fishing rods to earn money to buy the necessary equipment for making new ones. Repairing rods is still an important factor in his livelihood and the mail brings him old rods from Maine to California to repair, as well as new orders.

"The first pole I made was a green hickory fly rod I whittled in my own kitchen for practice," Mr. Barker said.

"The first rod I sold was to a Marysville man who wanted a high-class rod without paying a fancy price for it."

The workshop in rear of the pleasant little farmhouse today is filled with replicas, in various states of manufacture, of that first rod. The secret of its grace and strength is its six-ply form and air conditioning.

"A TREE root with its tendrils wound around each other gave me the idea," Mr. Barker said. "Instead of making a solid piece rod, I determined to make my rods stronger by fitting longitudinal strips together with glue. Only the trunks of young second-growth hickory and ironwood will fit my purpose. I cut them in my own woods, split the logs lengthwise and have the halves quarter-sawed and cut into slabs in a planing mill, and do all the rest of my work in my own shop."

At first, the rods were made in halves glued together. Then Mr. Barker experimented with six-ply rods. This necessitated buying a motor driven mitre saw to cut the triangular sticks from the slabs. Proceeds from the repair business furnished the funds. A (Continued on page 105)

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POPULAR SCIENCE MONTHLY

Secrets of Success

RUNS UNIQUE BUSINESS FROM FARM WORKSHOP

(Continued from page 104)

new electric motor long ago replaced the first gasoline motor. Mr. Barker believes in this slow, sure method of building reputation and trade.

He deals directly with his customers. He has no sales agencies. He guarantees an excellent product and stands back of the guarantee. His advertising necessarily is limited in quantity and is confined to national sport and field publications.

In one corner of the workshop hangs a whopping big fly rod. Mr. Barker calls it "The Club". There is no price on it. It's the first rod Mr. Barker made, the experimental fishing pole he carved in his kitchen with a jackknife when he started out to lick his own personal depression.—W.H.M., Columbus, Ohio.

HE FOUND MONEY IN OLD BURLAP BAGS



EVERYONE knows the high margin of profit that exists in the junk business but most of us would consider it very undignified to drive an old broken down horse and wagon and announce the fact to everyone in sight or hearing. Yet one man I know has made this business almost dignified without impairing its profits in any way—and that's Sam's story.

Before the depression and half way into it, Sam clerked in one of our large department stores. Of course the day came when the boss approached Sam and with a doleful expression gave Sam his notice and a sorry picture of the firm's business of the present and the future. Like the rest of us, Sam thought that in a month or two, things would pick up and that his small bank account would carry him over, but, the bank suspended withdrawals until further notice and things looked very dark for Sam.

One day a neighbor offered Sam about a hundred and fifty burlap bags and told him to dispose of them in any way he saw fit. Naturally, his first thought was to sell them to a junk man for a cent or two apiece but the thought of a junkman gave him an idea.

The next morning Sam took about twenty bags and went calling on his neighbors. He asked them to hang the bag in some convenient place and instead of burning their (Continued on page 106)



Copy this girl and send us your drawing—perhaps you'll win a **COMPLETE FEDERAL COURSE FREE!** This contest is for amateurs, so if you like to draw do not hesitate to enter.

Prizes for Five Best Drawings—FIVE COMPLETE ART COURSES FREE, including drawing outfit. (Value of each course, \$190.00.)

FREE! Each contestant whose drawing shows sufficient merit will receive a grading and advice as to whether he or she has, in our estimation, artistic talent worth developing.

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RULES FOR CONTESTANTS

This contest open only to amateurs, 16 years old or more. Professional commercial artists and Federal students are not eligible.

1. Make drawing of girl 4½ inches high, on paper 8 inches wide by 7 inches high. Draw only the girl, not the lettering.
2. Use only pencil or pen.
3. No drawings will be returned.
4. Write your name, address, age and occupation on back of drawing.
5. All drawings must be received in Minneapolis by Sept. 25th, 1934. Prizes will be awarded for drawings best in proportion and neatness by Federal Schools Faculty.

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Name.....

Present Position.....

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Secrets of Success

HE FOUND MONEY IN OLD BURLAP BAGS

(Continued from page 105)

waste paper and old magazines, to deposit them in the bag and that he would call every week and collect it and in addition he would give them a credit card which when properly filled would entitle them to a cup and saucer free of charge. The prospect of a free gift usually won them over. Of course, there were a few refusals but on Sam's next trip they usually asked him for a bag and credit card. The next day Sam distributed the rest of his bags and a profitable business was soon in the process of being launched.

Sam's method was: For each pound of paper he gave a credit point. One hundred credit points entitled the holder to a cup and saucer which cost Sam ten cents. Sam baled the paper in a home-made paper baler and received between sixty and eighty cents a hundred pounds from a wholesale dealer. For magazines that were in fair shape second-hand book dealers gave him from one to two cents each. When his small touring car proved inadequate to making his collections, Sam built a trailer with a high stake body.

The original 150 bags has been increased to 450 and Sam says he is going to get larger bags so he only has to call once every two weeks and at the same time can double the number of them in homes.—J.S.M., Cleveland, Ohio.

Cash Prizes

THIS department will give \$5.00 for every true success story submitted by readers of Popular Science Monthly, and which is accepted for printing in this magazine.

Manuscripts will be judged on the individual merits of the case and circumstances involved. Only stories in which the author's success, or that of some one known to the author, has been gained by some method of educational guidance, fitness for the job, or application to the work will be considered. We are not looking for the "get-rich-quick" type of story.

Manuscripts must be confined to 500 words or less. They must be true and, if accepted, authors must be prepared to give us signed statements to the effect that they are true. Manuscripts submitted and printed become the property of this magazine, and we are not responsible for the return of rejected stories unless postage is provided for this purpose. Address contributions to Success Story Department, Popular Science Monthly, 381 4th Avenue, New York City.

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HELL DIVER MODEL

(Continued from page 75)

be done by filing. Taper both wings on each end, about $\frac{5}{8}$ in. from the ends. Sand the surfaces with medium sandpaper across the grain, then with fine sandpaper first across the grain and finally with the grain. Fasten the lower wings with $\frac{1}{16}$ -in. diameter brads or wire. The vertical and horizontal tails are made of thin galvanized metal, although brass or aluminum may be used.

The landing gear is made of balsa wood, eight pieces in all. The wheels and "pants" are carved in one. This is easily done by laying out and shaping the top plan first, then the side plan.

THE two outside struts are of $\frac{1}{16}$ -in. brass or galvanized metal, two being required. The six inside struts are balsa wood $\frac{1}{16}$ by $\frac{1}{8}$ by $1\frac{1}{2}$ in. long to allow for fitting from the top wing to the fuselage.

The propeller is galvanized metal about $\frac{1}{32}$ in. thick and 3 in. long.

To assemble, lay out and drill the four holes in the fuselage for the brads for the wing pieces. Also mark the place for the outside struts that go from the top of the bottom wing to the bottom of the top wing. Cut these eight small slots about $\frac{1}{16}$ in. deep with a razor blade. In the middle piece of the top wing, four extra holes are cut for the inside struts, also somewhat deeper slots for the landing gear on the bottom.

Glue the bottom wing to the fuselage, put the outside struts into the slots, set the top wing on top of the struts, and hammer it down. Fit and glue the six inside strut pieces from the top wing to the fuselage. Glue the pieces with the shock absorber to the wheel pants, then glue to the fuselage, seeing they are at the correct angles, and glue the inside brackets to the bottom of the shock absorber. Glue the braces from the bottom of the fuselage and lower wing to the pants back of the landing gear braces.

For the cockpit hoods it is best to make a thin cardboard pattern. Cut the excess material away to fit over the cockpits; then cement the pattern in the right shape. Lay cellophane in this pattern, leaving it oversize all around. Next glue in the balsa wood supports, which are $\frac{1}{32}$ in. thick by $\frac{1}{16}$ in. wide and of a length to fit the pattern. Twelve pieces are required in all. Use a clear cellulose cement. Finally cement the hood to the fuselage.

Give the entire model a coat of flat white. Use black over this in the cockpits and around their edges. The back and front of the cowlings, where the cut-ins are, should also be black, and the wheels as well. The rest of the ship is blue except the wings and horizontal tail, which are buff. The vertical tail has red, white, and blue as shown. On top of the top wing are two insignia. These are placed over the outside struts and are about $\frac{1}{4}$ in. in diameter.

Please send in on a post card your suggestions for models to be included in this series. Since the last time we asked you to vote on this question, plans have been given for fourteen of the models requested.

SILENCING WHEELBARROW WITH RUBBER TIRE

THE noise and jar incidental to running a wheelbarrow over hard pavements may be reduced by the use of old bicycle tires. Cut an outer tire about 1 ft. longer than circumference of the wheel, and strip away the rubber for about 6 in. from each end so as to free the wires which are embedded in the rubber. After the tire is placed over the wheel, the wire ends may be twisted together or around a spoke—F. G. SEMPLE.

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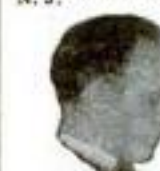
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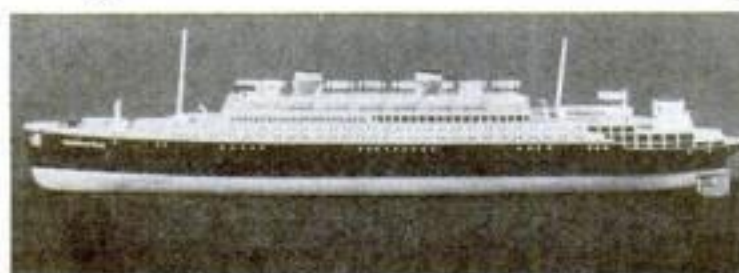
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NO. 6



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NO. 2



KIT A

a miniature model of a cup yacht. It is marked P in the following list. This kit is for the October model of the month, described on page 71.

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- P. Cup yacht 7½-in. decorative water-line model75
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- No. 4. Solid mahogany book trough 22½ in. long, 9½ in. wide, and 2¾ in. high over all. Ready to assemble, with finishes 5.30
- No. 5. Solid rock maple hanging wall rack with one drawer, 19½ in. wide, 33¼ in. high. Ready to assemble and stain included 5.75
- No. 6. Solid rock maple butterfly table, top 19 by 22 in., height 22½ in. Ready to assemble and stain included 6.90
- No. 7. Veneering kit with selected veneers, crossbanding material, inlays, tape, glue, veneer saw, and book of instructions, for veneering a coffee table, serving tray, mirror frame, book-rack, and jewel box 7.75

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Cutting Reeds

ON FURNITURE LEGS

By

Charles A. King

MANY amateur craftsmen who desire to construct a Sheraton worktable, chair, or other piece with graceful reeded legs, hesitate because they feel that making the reeds would be a step beyond their skill, especially if their lathe has no indexing attachment such as those now provided with the better grades of home-workshop lathes. That obstacle can be overcome once and for all by making the index and reeding gage illustrated. With this, any leg or post up to 2 in. square and 32 in. long may be reeded.

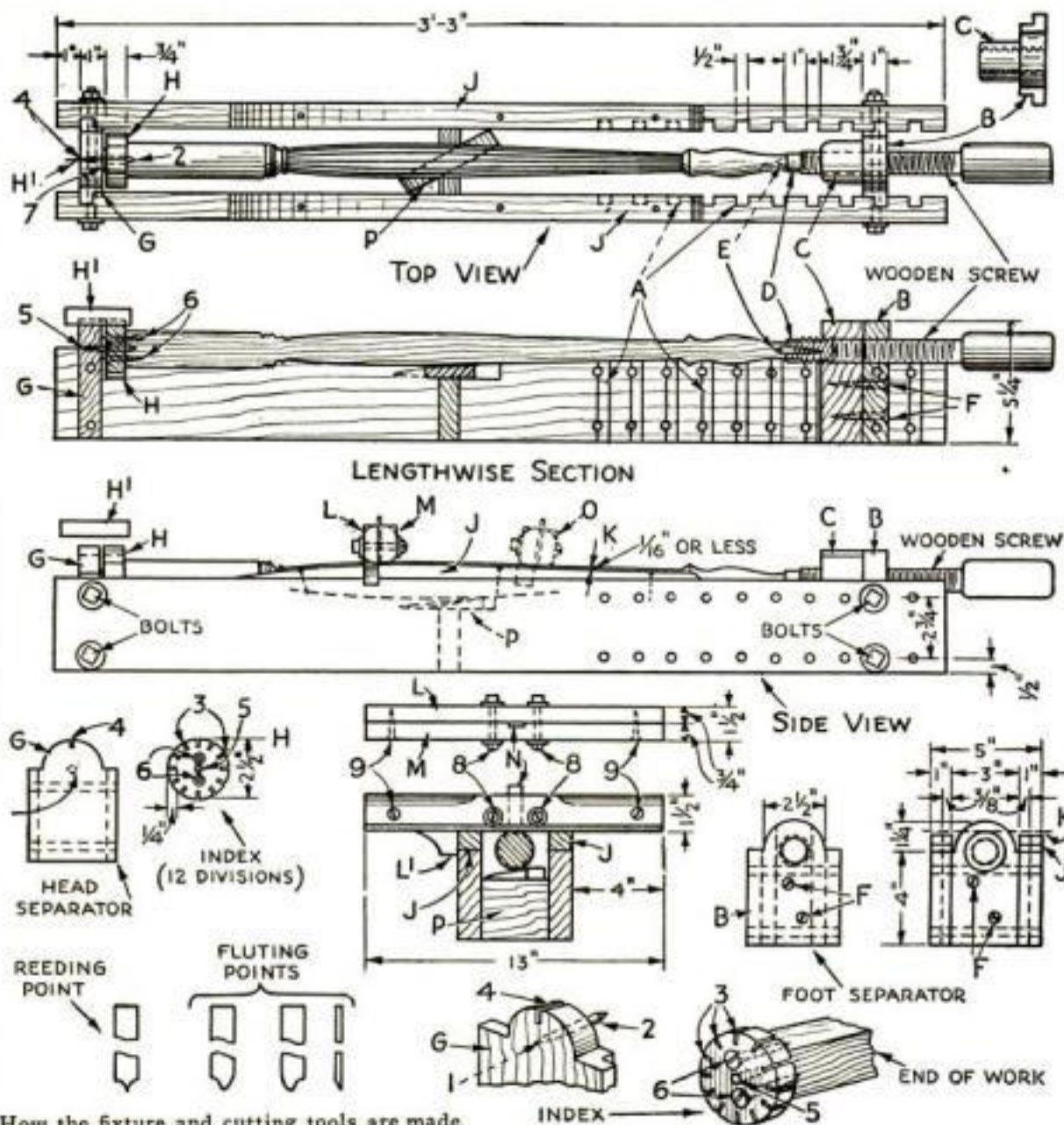
Get out two hardwood sides fully 1 in. thick, 4 in. wide, and 3 ft. 3 in. long, and two hardwood separators 1 by 5/4 by 3 3/4 in. Cut adjusting grooves A in the sides, and corresponding rabbets in the ends of the separators so they will fit the grooves as shown. Bore coinciding 1/4-in. holes through sides and separators to receive 5 1/2 by 3/16 in. bolts with washers. Do the boring from each side until the holes join smoothly in the center.

Bore a 7/8-in. hole through the foot separator B, its center on a line with the top of



An easily made indexing fixture for reeding or fluting the turnings used with various types of period furniture

the sidepieces. Fit a 7/8-in. wooden screw into a 1 3/4 in. square block as at C. A 7/8-in. screw and part of the jaw of an old hand screw will be just the thing for this. Place



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a ferrule on the end of the screw at D, turn a 1 1/4-in. No. 10 screw into the end as at E, and file the end to a carefully centered point. Fasten block C to B with screws as at F, making sure they clear the bolt holes. Turn a 2 1/2-in. No. 10 screw into head separator G at the center I, allowing it to project 1 1/4 in. as at 2. File or grind the screw flush at I and to a carefully centered point at 2. Assemble the separators and sides to suit the length of the leg to be reeded.

MAKE the index gage H of maple or other hardwood 3/4 by 2 1/2 by 2 1/2 in. If glued of crossed veneers, there will be no danger of its splitting. Lay out and make twelve 1/4 in. deep saw cuts (these are marked 3). The accuracy of the finished reeds depends upon the spacing of these cuts. This index gage will suit 3, 4, 6 and 12 reeds, but other gages may be made to suit any desired number. The same gage may be used for any diameter of leg.

Make a cut in the head separator at 4 to coincide with the cuts in the index. In the index piece at 5, drill an accurately centered hole which will slip closely over the screw I. Bore holes for the two screws 6 in the index.

Center the index on the end of the leg, fasten with screws 6, place an iron washer at 7, put the leg and index in place, and center the foot at E. Fit a piece of steel (marked H¹) closely into the saw cut 4 and the uppermost saw cut in the index piece. By turning the gage H and dropping H¹ into any cut in the index, the leg will be held in position while being reeded.

Make pieces J the same shape as the section of the leg to be reeded. Fasten these to the sides with brads so their top edges will be 1/16 in. or less below the profile of the leg as indicated at K, to allow for the spring of the leg while reeding.

MAKE the reeder of 3/4-in. maple. Piece L is 2 1/2 in. wide, piece M 1 1/2 in. wide, and both 13 in. long. Cut piece L so that it has a gaging angle or shoulder at L¹, and shape the remainder of it down to 1 1/2 in. to coincide with M. Fit 1 3/4 by 1/4 in. stove bolts at 8, and 1 1/4-in. No. 10 screws at 9. Make the cutter for reeding 1/8 in. or less thick, 1/2 in. wide, and 2 in. or more long. Use a piece of tool steel or a flat file. Cut notch N in the holder to fit the cutter closely and so it will be gripped firmly by setting up bolts 8. Drive screws 9 home to hold pieces L and M in place, and round them for the handle. Round the bottom enough to allow the reeder to be tilted as at O to regulate the depth of the cut.

Begin at the bottom of the reeded section and make the stroke down the leg. It may be necessary to finish the ends of the reeds with a gouge or chisel. In any case they must be sandpapered thoroughly.

Flutes may be cut by the same method by using two cutters as shown and making two cuts for each flute.

Often it will be a good plan to place a block and wedge as at P to give additional stiffness. In using the reeder, be sure the gage face L¹ is pressed firmly and evenly against the side. All places where there is friction should be rubbed with a candle or with hard soap.

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CONN

World's Largest Manufacturers of BAND INSTRUMENTS

NEWEST EFFORTS MAY HARNESS SUNLIGHT

(Continued from page 33)

mechanism made it possible to shift the reflector to follow the movement of the sun.

Attached to the lower base of the reflector, its axis the same as the reflector's, was the boiler, a blackened cylinder made of copper about one-tenth inch thick, eleven inches in diameter, and thirty-two inches long, enclosed by a glass cylinder four inches greater in diameter. The space between the boiler and its enclosing glass cylinder was filled by a two-inch layer of hot air. Inside the boiler was another copper cylinder, somewhat smaller in diameter, only twenty inches long, and hollow except for feed and steam pipes. About twenty-one quarts of water could be heated between the two copper cylinders, and the steam chamber had a capacity of about ten quarts. On a bright day, the sun's rays concentrated on the boiler by the reflector produced a steam pressure of thirty pounds per square inch in forty minutes. The pressure then was raised rapidly to seventy-five pounds per square inch, the safety limit of the lightly-constructed boiler. On a very warm day the boiler vaporized over five quarts of water an hour, and the small engine it ran, driving a pump, developed one-half horsepower.

WITH the financial assistance of the French government, Mouchot continued his solar-power experiments for twenty years. One of his later plants had a boiler made of several tubes placed side by side, which, when tested over the span of a year by independent engineers, showed the excellent boiler efficiency of forty-nine per cent. Some of his plants were used successfully for pumping water in Algeria.

In America, John Ericsson, the Swedish-born engineer and inventor who had done his adopted country so valuable a service by designing the *Monitor* that sank the Confederate ironclad *Merrimac*, was working industriously on the problem of obtaining cheap power from the sun. In 1883 he built in New York a solar power plant, his eighth, that was comparatively inexpensive and highly efficient. The reflecting apparatus consisted of a rectangular trough eleven feet long and sixteen feet broad, built of straight wood staves supported by curved iron ribs. To these staves were attached mirrors made of common window glass silvered on the underside. The trough, revolving around a pivot so that it could be made to follow the movement of the sun, was supported by light steel trusses, to which was attached a water heater six and one-fourth inches in diameter and eleven feet long. The sun's rays concentrated on the heater by the reflector produced sufficient steam to operate an engine with a six-inch working cylinder and an eight-inch stroke. Ericsson was eighty years old when he built this machine. Had he been younger it is probable that he would have developed it to very high efficiency.

Other inventors continued working on the problem. In 1904, residents of Pasadena, Calif., were astounded by the erection of the largest and most powerful mirror-type solar generator that ever has been built. The brain child of Aubrey G. Eneas, an Englishman living in Boston, it had a cone-shaped reflector thirty-six feet in diameter that weighed over four tons, moved by a clock-controlled motor so as always to be in accurate focus with the sun. The mirrors of the reflector were of white glass, one-sixteenth of an inch thick, sprung to the curvature of the frame.

THE boiler, formed of two concentric steel tubes enclosed in two glass tubes with an air space between them, was thirteen feet six inches long, and was placed at the axis of the reflector. The water was circulated up

between the steel tubes, and down the inner tube. About thirteen and one-half square feet of sunshine was concentrated on each square foot of the outer surface of the boiler. The machine transformed about four per cent of the solar radiation intercepted by the mirror into mechanical work, and gave an all-day average of about two and one-half horsepower. Eneas built several similar plants, which were used for pumping water, in southern California and in Arizona.

THE late Frank Shuman, of Philadelphia, came the closest of any of the sun harnessers to making solar generation of power a commercial success. Starting work in 1906 on the hot box principle, he built several successful experimental plants. In 1911 English capitalists became interested, and the following year he was invited to build a large sun-power plant in Egypt. Professor C. V. Boys, the English physicist who invented the quartz fibers now largely used in instruments of precision, and A. S. E. Ackermann, an English consulting engineer, became associated with Shuman in the work. At the suggestion of Professor Boys the design of the absorbers was changed from the old hot box to a reflector-lined trough something like the one that was used by Ericsson. The boilers were placed on edge at the focus of the reflectors, so that both sides would receive the reflected rays, and were covered by a single layer of glass enclosing an air space around the boiler.

Each channel-shaped reflector and its boiler was 205 feet long. The five reflectors were automatically heeled so as to follow the sun all day. A total area of 13,269 square feet of sunshine was caught, and the maximum amount of steam produced was twelve pounds per 100 square feet, equivalent to one brake horsepower per 183 square feet of sunshine. The maximum output for an hour's run was fifty-five and one-half brake horsepower, about ten times the power production ever before obtained by a solar-generating plant, and equal to sixty-three horsepower per acre of land occupied by the plant.

In 1916, while engaged in making solar-radiation observations at Mount Wilson, Dr. Abbot built a solar cooker that gives twenty-four-hour-a-day service.

EXCEPT that concentrated sun rays, instead of a fire, are the source of heat, and that engine-cylinder oil instead of water is heated, this apparatus is much like an ordinary bath-water heater. The sun's rays are reflected on a blackened copper heater tube, covered by two concentric glass tubes, by a cylindrical trough of light sheet steel lined with glossy sheet aluminum. This reflector, which is twelve and one-half feet long and seven and one-half feet wide, is mounted on a steel frame with its long dimension parallel to an axis pointing toward the North Star. An ingenious arrangement of counterweights, controlled by an inexpensive alarm clock, moves the reflector sufficiently for it to follow the daily march of the sun from east to west.

On a platform about six feet above the reflector stands a twenty-by twenty-four-by thirty-six-inch steel reservoir, with two ovens, each nine by eleven by sixteen and one-half inches, in its back. A copper pipe, one and one-half inches in diameter, passes down under the reflector, turns, and returns in the focus of the sun rays, as described.

Although shaded by trees so that only about seven hours of sunlight a day are available, the temperature of the cooker's ovens always remains above boiling, and many varieties of food may be cooked at night. At most times the ovens are hot enough to bake bread.

GLASS MAKING EASY FOR THE HOME CHEMIST

(Continued from page 59)

absorbent paper in a solution of turmeric in water and allowing them to dry. You can obtain powdered turmeric from grocery stores.

When using the test paper, first add a few drops of hydrochloric acid to the solution to be tested. Then place two or three drops of the liquid on the paper and allow the strip to dry. This can be done by placing it on the sides of a hot flask of boiling water. If the strip, which originally is yellow, turns pink where the liquid was applied, boron is indicated. As a double check, place the pink portion of the paper in ammonia water. If the first test is correct, the spot will turn black. Since boron is an ingredient of many eye washes, hair lotions, and throat gargles, the experimenter can use the turmeric papers he has prepared to test for its presence.

Another common compound of boron also is sold by druggists as a mouth wash or oral antiseptic. It is called sodium perborate and its cleansing properties are due to the fact that it gives off quantities of oxygen. This can be demonstrated by dissolving some of the powder in water and heating it, testing the gas by placing a small smoldering string close to the liquid. The glowing of the string will be evidence of the oxygen present.

Because of its high oxygen content, sodium perborate also will bleach the color from cloth. The colored portion of wood match boxes can be completely bleached out in a few seconds with a solution of the chemical.

By adding salts to a solution of borax, the home experimenter can produce various precipitates. Copper sulphate solution, for instance, added to borax solution, will form green copper borate. In a similar way, borates of nickel, iron, chromium, cobalt, magnesium, calcium, zinc, manganese, and aluminum can be made.

STUTTERING TRACED TO CHEMICALS IN BLOOD

THAT stuttering may be traced to the chemical content of the blood, is the suggestion resulting from researches carried on by Dr. George A. Kopp of the University of Wisconsin, Madison. Thirty-one persons afflicted with stuttering submitted to the test. The calcium content of the bloodstream was found by Dr. Kopp to be higher than normal in the people who stuttered. By changing this chemical characteristic of the blood, it is hoped the affliction may be cured.

DRUGS MAY BE USED TO PRODUCE SUPERMEN

DRUGS that, instead of producing stupor or frenzy, would produce super-men were predicted by Prof. Marston T. Bogert, of Columbia University, before a recent meeting of the American Chemical Society. Organic chemistry, Prof. Marston said, is only now learning the relationship between certain chemicals and their influence on the mental habits of man. It is inevitable, he continued, that one day chemicals will be found to stimulate the brain power of man and increase physical strength and health.

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THE green coloring matter of plants, chlorophyll, is being extracted in England for use in treating anemia. Spinach and lettuce are the plants from which the concentrated chlorophyll is most frequently taken. According to Dr. Peter E. de Rees, London pharmacologist, the plant extract is more easily assimilated by the system than the iron extracts and strychnine previously used.

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MAN-MADE LIGHTNING AND NATURE'S FREAKS

(Continued from page 114)

intensity and also, of course upon the relative inflammability of whatever it strikes.

What happened when lightning struck a tall tree, and knocked down a boy standing beneath it, was reported by an old New York newspaper as follows: "When the upper clothes were stripped from the unconscious boy, the doctors found a long, distinct image in blue of the stricken locust tree upon his skin. The image was clearer than if tattooed by hand, and reached from the boy's shoulder to his waist line."

THIS seemed like pure fancy. However, McEachron said, lightning actually has been known to leave such marks upon the skin of a person struck. Needless to say, the pattern was not, as the reporter believed, an image of the tree. It was the track of the electric arc itself.

A report from St. Johns, Newfoundland, told of a man who called up his wife, during an electric storm, to warn her not to use the telephone. As he was talking, lightning struck and he was killed.

"In rural communities," McEachron explained, "it is wise not to use the telephone during a lightning storm. There is comparatively little danger in cities, however, where the telephone wires are underground. If the telephone must be used during a lightning storm, it is not desirable to put the receiver tightly against the ear, as the lightning discharges very often produce an effect known as acoustic shock which may impair the hearing of the user. Holding the receiver a short distance from the ear will minimize the effect."

What should a person do who wishes to safeguard himself and his home against lightning? Here are some pointers suggested by McEachron for the man who wishes to play extra safe:

First, has his home a lightning rod? This homely protection, McEachron told me, stands forth today in better repute than ever before as a protection against lightning. Its need is confined, however, to the isolated country home. City dwellers, for the most part, do not realize that their homes are provided with an effective substitute for a lightning rod. Their plumbing systems invariably include a vent pipe that extends upward to or through the roof, and this takes the place of any special installation against lightning. Steel-framed skyscrapers, of course, are natural lightning rods. The Empire State Building has been struck by lightning as frequently as a dozen times in fifteen minutes, without damage and without the least inconvenience to its occupants. Beyond a slight jar, they never realized what was happening.

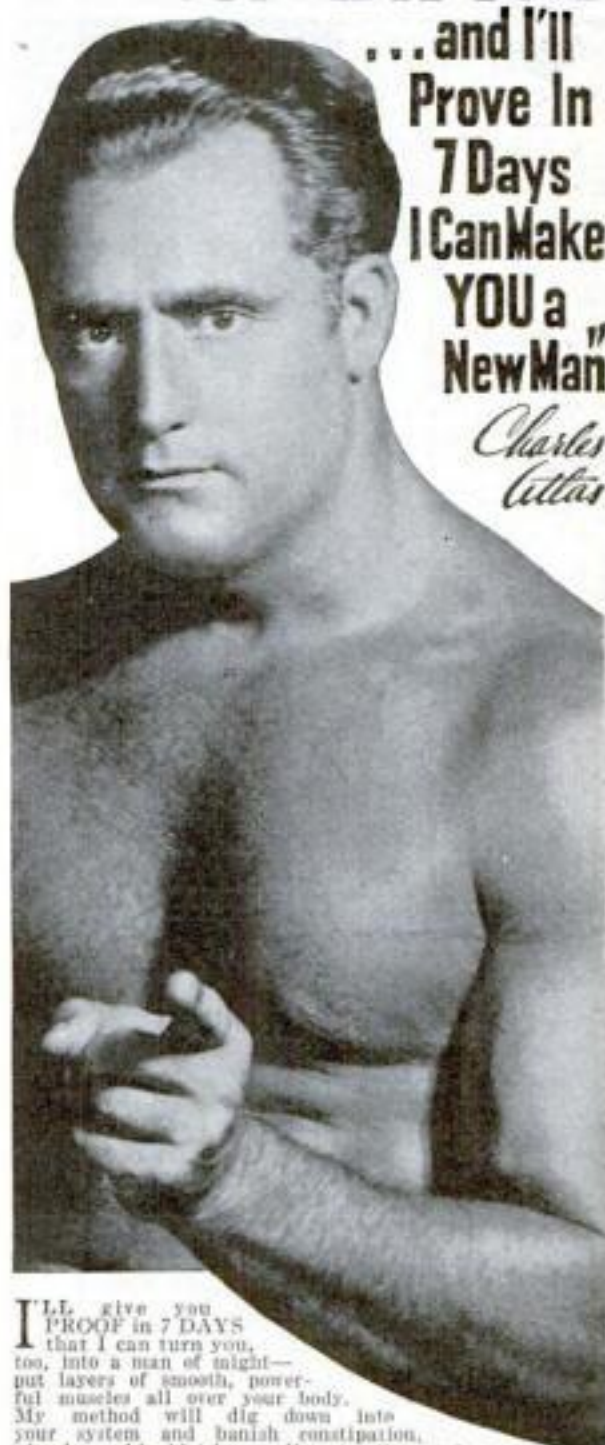
At worst, lightning may strike a roof and tear off a few shingles, or even set the roof afire, but its chances of harming the occupants of a house are comparatively small. The plumbing system, the heating system, and the electric wiring system provide paths that except in rare instances will carry even so terrific a current harmlessly to earth.

KNOWING that lightning follows these paths, a person who wished to use particular caution would avoid being near them during a storm. Since the plumbing, for instance, usually runs through the center of the house, he would not stand too near one of these walls, lest a stray bolt might find its path not sufficiently conducting and leap erratically sideward. Especially, he would avoid standing between two such conducting paths, as a water pipe and a radiator. However, the chances of the average person being struck by lightning are so small that he need not worry about it.

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THINGS I LEARNED FROM 10,000 CATS

(Continued from page 43)

the expectant mother to live as before, ex-
cept that she should have plenty of raw meat,
which is nourishing but not fattening. Dur-
ing the last two weeks before the young ar-
rive, give her plenty of milk if you find it
agrees with her. This for the benefit of the
young.

If you have no male at home and desire
to breed your female, it will be perfectly
safe to take her to a cattery for breeding.
She may be bred easily with a male of her
acquaintance, or if a strange male is brought
in for the purpose place them in separate
cages separated only by a wire mesh. Usu-
ally they will become acquainted in two
hours. When it becomes apparent that they
will not fight, open a door permitting them
to meet at their own free will and conven-
ience. Never force them together.

A CAT of good breed should always be
color-bred. If you have a blue female
Persian, breed her only to a blue Persian. I
know of few cases where colors were satis-
factorily crossed. One color, the rare and
exquisite tortoise shell, is confined to the fe-
male Persians. This color is best bred to red,
from which union you may expect tortoise,
black, red, and sometimes cream kittens. Bred
to any other color, the tortoise-shell likely
will produce an unlovely offspring. Black, for
instance, generally gives a rusty black, as
common in appearance as any alley cat.

Kittens may be expected from sixty to
sixty-six days after mating. During that per-
iod keep the prospective mother quiet and
do not permit strangers to excite her. It is
better, in fact, if she is kept quite alone. Give
her, not a soft pillow, but a few layers of
newspapers covered by a section of blanket.
About a week before the litter is expected,
decide for yourself where you desire the event
to take place, then make the bed there. This
may be in a clothes closet, on the back porch,
or during warm weather, in the garage or
barn.

If you select some place exposed to the
sun, it is important to curtain off the direct
light during the first two or three weeks of
the kittens' lives to protect their eyes.

If more than five kittens arrive, the moth-
er will need help in feeding them. If you
cannot find a foster mother, you can hand
feed them either through a medicine dropper
or a doll bottle and nipple. You will find
they will take food in this manner as easily
as will a human baby. For food dilute any
good brand of canned milk with an equal
amount of water. Give it warm three or four
times daily. Although litters will average not
more than five, I have had as many as ten
arrive; it pays to anticipate a large family.

After the kittens arrive the mother re-
quires, to keep up her strength, two solid
meals every day, including two generous
helpings of milk. I always prefer canned
milk, diluted one-half. The solid portion of
the meal may consist of raw beef, cooked liv-
er occasionally, or tripe well done. If the
mother appears run down, give her ten drops
of good codliver oil twice daily. Be careful
not to increase the dose, for it will upset her
digestion.

YOU may start feeding the kittens when
they are four weeks old, or earlier if they
fail to thrive on their natural food. Start
with milk. Since it is difficult for them to
unlearn habits once fixed, it is better to start
right. Place a bowl of milk before them. Dip
your finger in the milk, rub it on their noses
and immediately nature tells them to lick it
off. They discover they have encountered the
taste somewhere before and begin to explore
—in the bowl directly before their eyes.

Beyond giving them this little start, leave

the kittens strictly alone. They open their
eyes from seven to twelve days after arrival.
Most of them thrive without personal atten-
tion. If one appears to be weaker than his
brothers, give him one drop of codliver oil
twice a day.

ALTHOUGH cats are subject to many ail-
ments, those kept under sanitary condi-
tions will require little attention. Their trou-
bles may be narrowed to these five: hairballs,
gastritis, ringworm, eye trouble, and ear
trouble. Fortunately, all may be cured.

If you think your cat has accumulated
hairballs in the stomach, which usually oc-
curs during the spring and summer, when he
is shedding, give him a teaspoonful of white
vaseline, placed against the roof of the mouth.
Do not melt the vaseline. He will lick away
the solid vaseline and as it reaches the stom-
ach it softens the hair and enables him to
eliminate it. Hairballs may produce dire re-
sults since they clog the digestive tract.

Gastritis is very dangerous and should be
attacked immediately. It usually develops
during hot weather, possibly a combination
of heat and over, or wrong, feeding. I have
found it effective to give milk of magnesia.
Dosage may vary from one half to a tea-
spoonful, given only once, followed by one
fourth of a teaspoonful of milk of bismuth
every two hours as long as needed, for five-
weeks-old kittens, to four times as much for
full-grown cats.

Ringworm or eczema, oddly, is highly con-
tagious. The cause? A debatable question.
Some think it comes from wrong feeding. I
am convinced that people who keep their
cats away from contact with other diseased
animals will save them trouble of this kind.
I know from experience it occurs largely from
contact. Troublesome as it is, the cure may
be effected rather simply by applying iodine,
full strength, to the affected part; three treat-
ments, given every other day, usually suffice.

EAR MITES, which are contagious, are a
principal cause of illness. In a severe
case remove the bulk of the dirt with a hair-
pin. Wipe out the remainder with a cotton-
wrapped toothpick or match. Sprinkle with
dry boric acid once daily for five days if
necessary.

If any tartar appears on the cat's teeth,
take him to a veterinarian for cleaning. Other-
wise, you may clean his teeth by rubbing
with a baby's tooth brush dipped in salt wa-
ter. When nearly through, dip the brush in
magnesia. This is good for gums and digestion.

These animals, fortunately, are naturally
clean. If you have a sand box with sides low
enough to permit the kitten to climb over,
you will find he will go to it as soon as he
leaves his bed. It is important to make the
box easily accessible because the mother re-
fuses to care for her young as soon as they
begin to eat.

Exercise and sunshine are important. If
you live in a city, build a miniature balcony
with two or three short boards outside a win-
dow, screening it to keep the animal safe.
With the window open he can range around
the room and sun himself on the balcony
whenever he desires. By suspending the bal-
cony from the casement, you can shut the
window with the cat outside.

If your cat is kept indoors, place a scratch-
ing board upright on the back porch. These
may be purchased at pet shops. But do not
think that this solves the scratching problem.
Always keep the points of the toe nails cut
off to save the furniture. Hold the cat fac-
ing away from your body, grasp the paw
firmly in one hand to spread the toes and
clip with small scissors or pincers.

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NEW PROCESSES ON WORLD'S FINEST FARM

(Continued from page 51)

countless barns. The experts did not wait until damage was done; they took time off from their major investigations to solve the problem. They placed thermo-couples, which generate electricity when heated, in the hay lofts of the barns. On the instruments operated by these tireless watchmen, observers could note the temperature of the hay during every stage of the curing process.

IN THEIR investigation of hog feeding, the experts upset another principle of long standing. Instead of feeding hogs as much as they could hold, as many farmers do, the Beltsville farmers kept their hogs on a diet which, according to a hog's standard, amounted to virtual starvation. The restricted feedings, however, included a portion of grain. The hogs not only attained good weight but the flesh was leaner and more valuable.

One experiment conducted on the farm did not turn out the way the experts wished. It disproved the very point they were trying to establish. It had been supposed for years that goat's milk was vastly superior to cow's milk in the diet of ailing babies. The former was believed to have a softer curd and smaller fat globules. To find means of increasing the supply of the greatly esteemed milk, a herd of goats was raised on the Beltsville Farm. Milk from the herd, as well as from cows being tested on the farm, was fed to babies in the Johns Hopkins Hospital and the Crittenden Home in Baltimore and the results carefully tabulated. To the surprise of the experimenters babies fed on the better grades of cow's milk gained weight much more rapidly than those given goat's milk. The latter, as previously believed, had the softer curd and smaller fat globules, but the cow's milk, because of higher nutritive value, proved the better baby food.

When the experimenters got around to the job of increasing milk production of cows and goats, they made what is probably the most sensational discovery known to dairying. Much progress had been made in the same direction by breeding, yet pedigreed cows of stocks that should have guaranteed high production often turned out to be inferior milkers. Attacking the question from a new angle, the experts found that scanty milk production in a cow was caused by deficient secretions from the pituitary gland. An extract of this gland was injected into a cow that was far below average. The cow's production of milk increased immediately.

NOT content with thus stimulating the growth of farm animals, increasing their productiveness and improving the flavor of meat, the experimenters created a new animal. The creature produced was a modified Persian of Karakul lamb, a central Asiatic animal prized for its tightly curled, furlike wool. The importation of Persian sheep into this country was forbidden several years ago as a precaution against the introduction of animal diseases, but enough survived of those previously imported for the Beltsville farmers to start a herd. The pelts of these animals, however, were not quite up to the desired standard so the experts tackled the job of producing better and more lustrous coats. Breeding a Karakul ram to a Corriedale ewe, they obtained hybrid lambs with coats the equal of the finest imported Karakul.

More than \$1,500,000 has gone into the experiments conducted at Beltsville Farm during the past year. The amazing results already achieved may persuade Congress to approve the projected \$1,500,000 appropriation for next year. If they do, the stock and dairy farmers of the country may see developments that will revolutionize their industry.

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TRAPS TO AVOID IN BUYING A USED CAR

(Continued from page 68)

finishes can be just as misleading as speedometers," said Gus. "It's a sight cheaper to polish a car or slap on a thin finish than it is to overhaul a motor. You want something you can drive, not a piece of furniture."

As Gus talked, he ambled around to the driver's side of the car and, opening the door, pointed down at the accelerator.

"It took more than 18,000 miles of driving to wear those pedals that smooth. And look at the play in this steering wheel," he added twisting it first one way and then the other. "It shouldn't swing more than two inches without moving the front wheels."

"In other words," chimed in Fred with a chuckle, "it's no bargain at any price."

"Well, you can do better," answered Gus.

SOME five or six cars further on down the line, Gus paused beside an open roadster that looked to be in first class shape. Squatting down beside one front fender, he beckoned to Fred.

"See that rough spot on the frame?" he asked, rubbing his thumb over the metal. "Looks like rough paint, doesn't it? Well, it's not. That frame has been cracked and welded over. When I first looked at this car I had a hunch it had been in a smash-up."

Fred looked questioningly at the car and then at Gus.

"That's a brand new hood on there," pointed out Gus, "and when a car hits something hard enough to push a hood into a mess of wrinkles, I don't want it."

"Another place where a crash leaves its calling card," Gus continued, "is on the metal dash back of the motor where the stay rods for the top of the radiator are fastened. If it's dented and messed up or the rods are bent, it's a safe bet the radiator was so smashed and twisted it had to be replaced."

"If a car's been in a sideswipe or has skidded sideways into the curb, chances are the frame has been twisted. That'll show up in the tires. If they're pitted or worn in spots, it'll pay to have the frame checked."

"But how about prices?" interrupted Fred as he examined the tag on a small sedan. "How can you tell what a used car is worth? Isn't there some way of getting a peek at one of those rate books dealers have?"

"NO NEED to," replied Gus. "It's pretty safe to figure that the value of a car goes down a little less than half the first year, a third more the second year, another quarter the third year, and still another tenth the fourth. That means a car that sold for \$800 in 1931 isn't worth more than a little over two hundred in 1934."

"Don't worry so much about the price but make sure you're getting your money's worth. Don't even consider a car before you've put it over the jumps up hills and on the level. Drive it slowly as well as fast. Listen for thumps and knocks and don't forget to give the brakes a good try."

"Then when you've finally decided that it's just the car you want, get a look at the bill of sale. If more than two people have owned the car, I'd think twice before I bought it. It may have been a lemon right from the start and four or five owners and several years of use won't improve matters."

"Gosh," exploded Gus as he pulled out his old-fashioned watch. "Look at the time. I was supposed to be over at the freight station half an hour ago."

"Well, now don't do anything rash," he added as he turned to go. "Take it easy and drive three or four of them before you decide. And by the way, if you want to, drop in at the Model Garage, I'll be glad to give them the once over for you."

TESTS EXPLAIN RAINBOW AND SUN'S GREEN FLASHES

(Continued from page 53)

color display that the sun paints is both more commonplace and more magnificent, particularly when the conditions are such that the beautiful secondary bow, with the colors reversed is formed outside the primary one.

As everybody knows, this lovely picture is painted by the sun only when it shines from behind the observer upon a curtain of falling raindrops. The sunlight falling upon each drop is bent upon entering the tiny liquid sphere above its center, is then reflected from its concave mirrorlike back and is bent again on issuing from the bottom of the drop as a band of color.

IT IS perfectly easy to see, through a simple experiment, just how this is done. Two flasks filled with water and held by an upright support, represent two greatly magnified raindrops. The sunlight, coming from behind the observer, falls upon the two flasks through a narrow slit in a cardboard screen. Through this same slit the observer looks. If you wish to try this experiment at night, a bright electric light can be substituted for the sunshine.

The diagram inset in Figure 2 traces the course of several parallel rays of sunshine on their course through the raindrops. Rays A, B, C, D are scattered after leaving the drop and, multiplied by millions, cause the whitish semi-circular area you see inside the primary bow. Ray G, bent sharply inward across E and F, also contributes to this area of scattered white light. No light is thrown outside the bow; and that is why the sky always appears darker there than inside the bow.

Rays E and F emerge more nearly parallel than any of the others. It is these that, refracted slightly, according to their wave lengths, reach the eye as the rainbow's spectrum. The violet light, being refracted more, is thrown higher than the red, which is bent less and crosses to the eye lower.

At this point some good observer is going to object that the primary rainbow in nature has the red band outside and above, with the blue edge inside and below. This question caused me plenty of confusion when I was developing this equipment, until I remembered that the spectrum colors appearing along each spoke of the bow's wheel are not all contributed by a single drop. We can imagine how in nature each separate shade and tint in between the red and blue is furnished by a separate raindrop, their combined colors reaching the eye as a single spoke in the complete bow's wheel of prismatic color.

THE secondary bow is formed by a double internal reflection of rays entering the drop from below instead of above its center. This accounts for the reversal of colors in the secondary bow. You will hear some people explain this reversal by saying that the secondary is a reflection of the primary on the water drops farther out. This is wrong; each low is formed separately.

There are several other interesting stunts you can do in unscrambling the rainbow. Perhaps the best is to allow the sunlight to fall upon one of the flasks through a hole in a piece of heavy paper, upon which the complete circular spectrum cast by each rain drop is painted by the rays passing through the drop in all directions. This experiment illustrates the whitish interior area of the bow. It also shows the darker area outside the bow.

An interesting point is that each person sees his own rainbow. Your companion, standing beside you to admire the lovely spectacle, really sees a bow formed by an entirely different set of millions of drops of rain. For that matter, your left eye can never see the same bow your right one does.

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HERE'S THE ANSWER

(Continued from page 67)

ingredients thoroughly and then spray the liquid on the clothes and the inside of the box or trunk.

Stains on Porcelain

R. T., BALTIMORE, MD. Stains on porcelain usually can be removed by washing the surface with a strong solution of oxalic acid. Use a brush or a small mop to apply the acid and do the scrubbing. Although oxalic acid will not harm the skin, it is poisonous. Sodium acid sulphate solution is another excellent cleaner for porcelain and stoneware that is easily obtainable.

Restoring Faded Photos

G. H., SEATTLE, WASH. A faded photograph often can be restored by first sponging it with water and then immersing it in a solution consisting of hydrochloric acid (two parts), sodium chloride (eight parts), potassium bichromate (eight parts), and distilled water (250 parts). This mixture will bleach the photograph after which it should be redeveloped using a dilute developer.

They Have So Far

Q.—WHEN a vessel sinks, does it go to the bottom regardless of the depth of the water? H. P. N., Roseville, Calif.

A.—SINCE the density of water is uniform, any body, heavy enough to sink below the surface of water will continue to sink. Its progress may be slow, depending on its weight, but it will eventually reach the depths of Davey Jones' Locker.

Preserving Books

V. F., WARSAW, MO. Leather book bindings can be preserved by applying a dressing consisting of equal parts of anhydrous lanolin and neat's foot oil. Mix the two thoroughly and apply the mixture with a soft brush. Then polish the leather with a soft cloth or a piece of lamb's wool.

Hydrogen or Oxygen?

R. K., SIOUX CITY, IOWA. Because early chemists thought all acids contained oxygen, the gas was given the name oxygen, which means "acid former." Later it was discovered that all acid contained hydrogen, not oxygen.

Black Lightning?

Q.—I TOOK a photograph of lightning recently. When the film was developed, black as well as white lightning appeared on the print. I have never seen black lightning before, can you explain it?—C. S. B., Bellows Falls, Vt.

A.—YOUR black lightning presents quite a mystery. It may have been caused by a partial reversal of the photographic negative due to over exposure. This often takes place when photographing the sun or any brilliant source of light; the sun on the finished print appearing as a black spot instead of a brilliant white disk. It also may have been caused by a shadow; the black zigzag line being nothing more than a shadow cast by some distant lightning flash.

The Earth's Travels

F. G. L., LAKEWOOD, OHIO. In its trip around the sun, the earth travels approximately 1,600,000 miles a day at the rate of 1,100 miles a minute, or eighteen and one-half miles a second.



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Machines That Will Fight the Next War

(Continued from page 15)

his planes from sea carriers stationed off our coast.

To do that with any degree of safety he would first have to destroy or effectively bottle up our fleet. Air strategists suggest the possibility that the Panama Canal might be put out of operation by a sea-and-air attack before a formal declaration of war, leaving our navy helpless in the wrong ocean. If that ever should happen, our cities on and near the opposite coast would be in real danger of air attack.

WHAT we should have, Air Corps officers insist, is a third department of national defense—an Air Department. Air warfare, they say, is more different from land warfare than sea warfare is different from land warfare. Infantry can march three miles an hour. Even motorized infantry can't move more than ten times that fast. Specifications of the new attack planes now being built for the Air Corps call for a top speed of 250 miles per hour and a maximum endurance of eight hours of flying at a speed of 220 miles an hour. The air-minded contend that making the airplane a member of the old army team of infantry, cavalry, and artillery is like putting a mounted polo player on a football team, and making him play according to football rules.

An independent land-based air force of 640 bombers, 640 patrol planes, and 200 heavily armed air cruisers with ten-man crews, on each coast, Air Corps officers say, would make us impregnable against attack from the air, and against invasion by a land army. The first cost of this huge air armada, with its necessary land facilities, would not exceed a half billion dollars, about one quarter of the first cost of our present navy, or of the amount we have spent on our land coast defenses, most of which are now of doubtful value.

While airmen are rather contemptuous of ground defense against air attack, land-force soldiers are confident that the improved anti-aircraft artillery developed during the past few years will bring down many a plane if it ever is fired against live targets.

The most modern three-inch anti-aircraft guns have a vertical range of 9,000 yards and a horizontal range of 10,000 yards. Four guns, mounted in a battery and controlled by a robot fire director, can put up a barrage of 100 mechanical-fuse twenty-six-pound shells a minute. Any plane within fifty yards of the burst of one of these shells is likely to be put out of action. The guns are aimed electrically by the remote-control director, which is a stereoscopic instrument of high precision with which observers follow the course of the fast-flying planes across the sky. All the gunners have to do is to set their fuses and load their guns. At night tremendously powerful searchlights make it possible for the observers to sight aircraft flying at altitudes as great as 15,000 feet.

Listening devices enable anti-aircraft troops to hear the sound of approaching planes while they are about ten miles away, and so give searchlight operators and gunners time to prepare to repel their attack. Large-caliber machine guns are provided for defense against low-flying planes.

MODERN anti-aircraft artillery undoubtedly will prove more effective than did the archies of the World War, which registered one hit to about 6,000 shots. But no matter how effective it may prove to be, no nation will have enough anti-aircraft artillery to use it in defense of every city in danger of

attack. Most of it will be devoted to the defense of important air bases and other vital strategic points.

A war between strong nations is almost certain to begin with a tremendous struggle for the mastery of the air. If one side wins that mastery, the next step will be violent bombing attacks on the enemy's airdromes, munition plants and transportation arteries and, perhaps, on his cities. If the rival air forces develop about equal strength, the initial air battle probably will end in a stand-off, and the job of fighting the war to its finish will pass on to the ground forces.

Army officers who feel no sympathy at all with the airman's desire for an independent air force have a strong appreciation of the airplane's value as an auxiliary of the ground arms, for reconnaissance, spotting artillery fire, low-flying attacks with machine guns and



LISTENING FOR AIR ENEMIES

This remarkable photo shows a group of anti-aircraft Army men using a sound locator to discover the whereabouts of attacking planes which are flying too high to be visible

small bombs on ground troops, and for the bombing of vital communication points within 250 miles of the enemy's front line. No general would be willing to go into battle without having plenty of attack planes, pursuit planes, observation planes, and bombers at his disposal.

It is not only in the air that the gasoline engine has revolutionized warfare. Motorization will make the next war a war of speed. Armies probably won't be so large as they were in the World War, but they certainly will move faster. Doughboys will be carried close to the battlefield in fast motor trucks. The guns of the artillery will be hauled swiftly into action by motor vehicles. Horse and mule transport will be a memory of the dead past. Even if the cavalryman still rides a horse, which is doubtful, he and his mount will be taken to the jumping off place in a motor truck.

Armies will be able to hit harder than they have in any war of the past. Weapons invented or improved since 1918 will give even small units terrific fire power. For many years our Springfield was the world's finest military rifle. Now it is practically obsolete. It is capable of fifteen aimed shots a minute, but that isn't fast enough shooting for present-day fighting. A new arm has been developed for our infantry—the Garand .30-caliber

semi-automatic rifle, which is capable of sixty aimed shots a minute. All other nations are arming their foot soldiers with semi-automatics. Efforts are also being made to perfect light air-cooled machine guns to replace the heavy water-cooled guns now in use. A model being tested by our Ordnance Department weighs only nineteen pounds.

In future wars, bringing up the gun will be a less picturesque but much speedier operation than it was in the past. Our standard field gun, the 75-mm., is now being equipped with balloon tires and spring suspensions which make it possible for a truck to tow it over roads at a speed of forty miles an hour without damage to its delicate mechanism. Even fifteen-ton howitzers are being built with mounts that make it possible to tow them at a speed of thirty miles an hour.

Prophets who thought that the tank would eventually develop into a sort of nightmare land battleship, were badly mistaken. The first World War tanks weighed thirty-five tons and had a top speed of about three miles an hour. Their tracks broke easily, and more of them were lost through ditching and engine failure than were put out of action by enemy fire. Modern tanks are considerably lighter. Their fire power has been greatly increased, their armor improved, and radio communication makes their tactical control fairly certain. On roads, using wheels, they have a speed of forty miles per hour. Using tracks, which can be attached in a few minutes, they can do twenty-five miles per hour across country. To be of value, tanks must be able to move fast. Direct hits by shells from one-pounder semi-automatic guns, an infantry arm, will put any known tank out of action. Bullets from .50-caliber machine guns, also an infantry arm, will penetrate their armor. Our army has only a hundred obsolete relics of the World War days, and a mere dozen of the modern tanks. Great Britain, Russia, and France have a great many modern tanks.

Robot warfare remains a dream of the distant future. Probably every important nation is doing secret experimental work in the radio control of ships, planes, and perhaps guns, but it is doubtful if anyone has invented a robot with the quality that the modern fighter most needs, intelligence.

At sea the next war probably will be less changed from previous wars than will the war on land. Aircraft will play a large part in it, but it has yet to be proved in actual warfare that air bombs can sink a warship. Submarines also will play an important part both as commerce destroyers and as fighters. But, so far as anyone knows, the battleship remains the backbone of naval power, even if the danger from submarines and mines makes the battle fleets spend most of their time in strongly defended harbors.

IT IS doubtful if the dreaded next war will be any more deadly than was the World War. It is extremely unlikely that great cities will be destroyed, and their millions of inhabitants slaughtered. The effort of each army will be to defeat the enemy army, and so win the war. The new weapons will be more efficient, and perhaps more deadly, than were the weapons of the past, but they will be no more cruel. Losses aren't likely to be heavier, for defense has improved as fast and as far as attack. And the next war will have at least one great advantage over the World War—it is almost certain to be much shorter. But it would be better to be sensible, and not have it.

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